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This handbook includes specifications, performance data, operating instructions, normal servicing information and parts list for the MARK-3 centrifugal fire pump unit.

The MARK-3 unit has been designed to meet all the requirements of advanced techniques in forest fire control, including USDA Forest Service Specifications No. 5100-274C. This versatile unit enables the pump to be used for high pressure and volume (B-2 volume Pump End interchangeability). It is also suitable for rural and municipal fire protection, or wherever a large volume of water or high pressure is required. Tandem operations enable to move water over greater distances or higher altitudes.

CHARACTERISTICS

Complete unit	58 lbs	26.3 kg
Height	16 1/4"	413 mm
Width	12"	305 mm
Length	23"	584 mm
Pump end only	15 lbs	6,8 kg
Max. engine power	10 HP	Approx. 7,4 kW
Carburetor	Tillotson all position diaphragm type with integral fuel pump and filter	
Ignition	Ducati electronic	
Spark plug	Borsh M4, AC 18 mm or Champion K7 18 mm	
Consumption approx.	(1 IMP gal, 1.2 US gals) 5 L/hr	

SPECIFICATIONS

The MARK-3 Pump end is an anodized horizontal 4-stage centrifugal precision built pump. Both the 2" (51 mm) NPSH male suction connection and 1 1/2" (38mm) NPSH male discharge connection are made to standard forestry thread specifications.

The MARK-3 Engine is a one-cylinder, two-cycle, air-cooled engine incorporating ball and roller bearings. The unit is also equipped with a rewind pull-cord starter and automatic cutout switch.

WARNING

- The improper use of this pump could result in serious injuries. Please read the manual before using your MARK-3 pump unit.
  - Always wear eye and ear protection when operating the pump unit.
- DANGER**

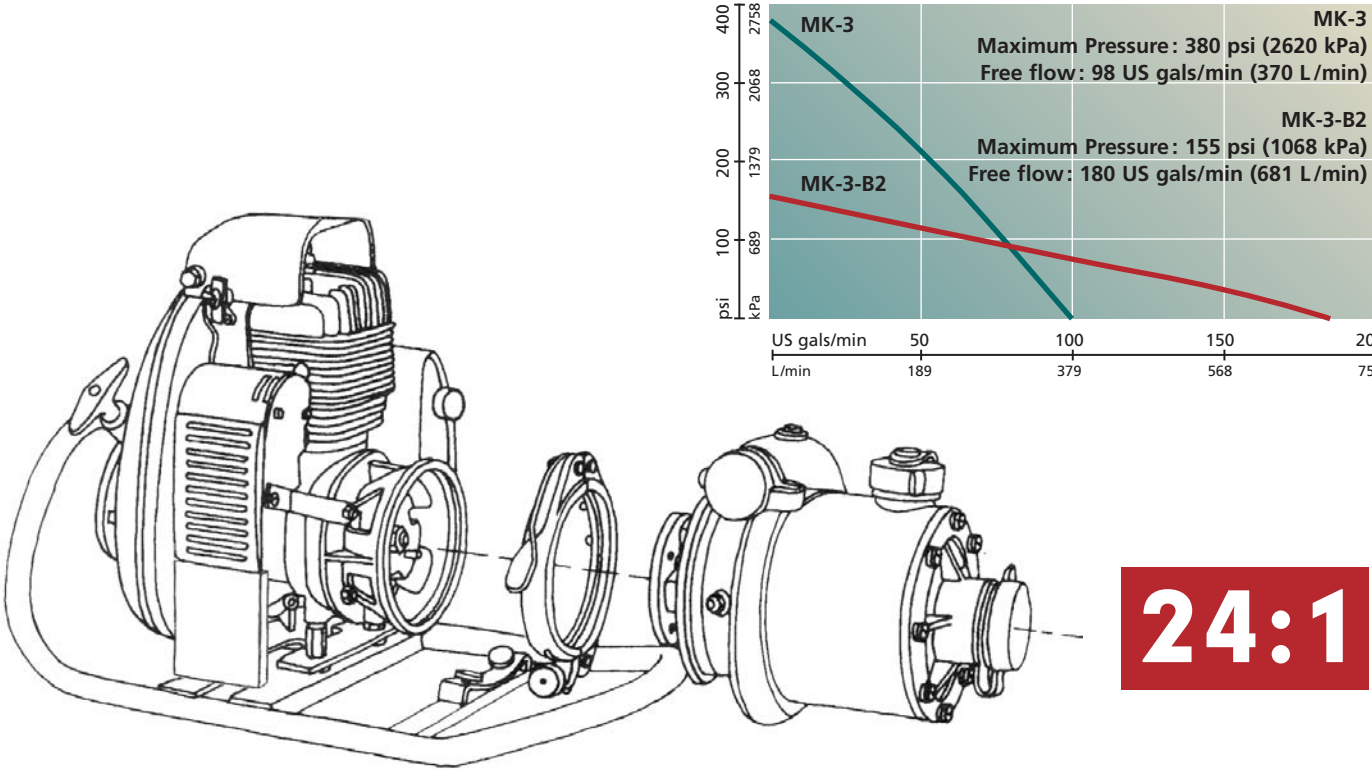
EYE PROTECTION REQUIRED

**DANGER**

HEARING PROTECTION REQUIRED
- Be careful, never touch the muffler, as it can reach very high temperatures and cause serious burns. Always allow enough time after stopping the unit for the muffler and surrounding parts to cool down.
  - Always use proper fuel mixture to ensure suitable lubrication.

MAXIMUM PERFORMANCE

Pressure			Discharge Flow		
psi	kPa	bar	US GPM	IMP GPM	L/min
0	0	0	98	82	371
50	345	3,45	89	74	337
75	517	5,17	83	69	314
100	690	6,90	78	65	295
150	1034	10,34	65	54	246
200	1379	13,79	52	43	197
250	1724	17,24	38	32	144
300	2069	20,69	25	21	95
350	2413	24,13	9	7	34
380	2620	26,20	0	0	0



1.1

SERIAL NUMBERS

Pump end serial number is located on the side of the pump (1.1).

Engine end serial number is stamped on a nameplate attached to the crankcase (1.2).

These serial numbers are the key to various design details pertaining to the original manufacture of each unit. Therefore, it is very important to specify serial numbers whenever ordering parts and tools or when requesting information.

DIRECTIONAL REFERENCES

All references to right side and left side of unit are made as they appear to operator when facing rewind starter, thus the carburetor is on the right side and the muffler is on the left side.

Viewed in this manner (facing the recoil starter), the engine will rotate in a clockwise direction (1.3).



1.2



1.3



## TIP

If the rewind starter should break while the unit is on the fire line, the complete rewind starter assembly can be easily removed, thereby gaining access to a manual starter pulley which is mounted on the fly-wheel. Using a rope, wrap around starter pulley and pull. Make sure rope wrapping will ensure clockwise rotation (from starter view).

## FOR TROUBLE FREE OPERATION

- DO NOT run engine at full speed until thoroughly warmed up.
- DO NOT lift strainer out of the water while pump is operating.
- DO NOT run engine with pump disconnected.
- DO NOT run pump when dry. Priming?
- Check strainer frequently to make sure that it is not clogged with moss, leaves, etc.
- DO NOT use suction hose without foot valve strainer.
- Remove and drain pump after final use.

## STARTER

The starter is an automatic rewind type. A proper operating technique will add many hours of life to the starter rope and starter.

Grasp handle firmly and pull slowly until resistance (past compression), then continue to pull with a short, vigorous stroke. Pulling handle sideways causes excessive wear. If kickback occurs, let go of handle immediately.

When engine starts, retain grip on handle and allow rope to rewind slowly.

Note: The rope should be replaced when wear is apparent.

See rewind starter Servicing and Parts, page 24.

## CAUTION

Not enough emphasis can be placed on the use of correct gasoline and oil mixture. Using less than the recommended portion of oil will cause overheating and possible engine damage. Using more than the recommended proportion of oil will cause spark plug fouling, erratic carburetion, excessive exhaust smoke and rapid carbon deposits.

## OPERATING INSTRUCTIONS

**OIL:** High quality 2-cycle mixing oil.

**FUEL:** 87 Octane or higher automotive gasoline.

**DO NOT** use premium grade gasoline.

Do not use poor quality oil, high detergent oil or oil with solid additives (graphite, moly, T.F.E., etc.).

### MIXTURE RATIO

Oil	Gasoline
1 L (0.22 IMP gals, 0.26 US gals)	24 L (5.3 IMP gals, 6.3 US gals)
1 US Quart (0.95 L)	6 US gals (5 IMP gals, 22.75 L)

## CONTROLS

There are only 4 controls which are used for normal operation: (1.4)

- 1 ON/OFF switch
- 2 Throttle lever
- 3 Choke lever
- 4 Reset lever

24:1



1.4



1.5



1.6



1.7



1.8

## TO START MARK-3 UNIT

- 1 Fill fuel supply tank with recommended fuel mixture.
- 2 Connect fuel supply line to fuel supply tank (1.5).
- 3 Attach fuel supply line to the adaptor located on right side of engine frame. Pump fuel to fill supply line (1.6).

**DO NOT use suction hose without foot valve strainer. DO NOT allow foot valve strainer to rest on bottom of lake or river bed.**

- 4 Connect foot valve strainer to male end of suction hose, then fill suction hose with water and connect to pump. 1 Use universal hose coupling wrench to tighten coupling firmly (1.8).
- 5 Connect discharge hose 2, nozzles, etc., to pump. Use a rope or other means to keep strainer at proper height, approximately 30cm (1 foot) below water surface. If strainer is too close to the water surface, it will draw air and pump may lose prime (1.7).
- 6 Fill pump with water manually or using a hand primer (B-5980), then replace priming cap and tighten firmly (1.8).
- 7 Move throttle lever to "Start" and "Warm up" position. Verify that On/Off switch is on "On" position (approx. 3 increments). Verify that the reset cutout switch is not engaged (must be pushed in).
- 8 Close choke, if engine is cold.
- 9 Slowly turn engine until resistance (past compression).
- 10 Give starter rope several quick, steady pulls until engine "coughs".
- 11 Open choke slightly and pull starter rope until engine runs.
- 12 Slowly open choke and allow engine to warm up for at least 2 minutes before using full throttle.

The **MARK-3** engine was initially run-in at the factory. Full throttle operation can be used provided the engine is given a thorough warm-up period beforehand.

**Important: Failure to allow the engine to warm up may lead to piston scoring and possibly more serious damage.**

## AUTOMATIC CUTOUT SWITCH

The **MARK-3** unit is equipped with an automatic cutout switch. This safety device will stop the engine instantly and thereby eliminate overspeeding.

The switch works on cooling fan air pressure. As the engine speed increases, so does the air pressure. At a predetermined speed, there is sufficient air pressure to cause the air vane to move against its contacts, shorting the ignition and thereby stopping the engine.

**When the cutout switch automatically stops the engine, this is a warning that there is a problem. Do not reset switch until cause of trouble has been identified and corrected.**

## TO STOP MARK-3 UNIT:

- 1 Move throttle lever to "Stop" position.
- 2 Allow unit to run for approximately 1 minute with throttle in this position.
- 3 Switch toggle to "Off" position.
- 4 Remove and drain pump after final use.

FLOODING

Flooding refers to an accumulation of excess fuel in cylinder, mainly due to excessive use of choke.

When the engine is in a flooded condition, an over-rich fuel-air mixture is induced into the cylinder. This mixture does not ignite readily and usually fouls the spark plug.

CLEANING A FLOODED ENGINE

Remove fuel supply line from engine or close fuel supply valve (if equipped). Remove spark plug. With both choke and throttle in fully open position, pull starter rope several times until excess fuel is exhausted. Before reinstalling spark plug, clean and dry electrode and insulator tip.

COLD OPERATION

In cold operation it is good practice to put a small quantity of aluminum compatible antifreeze into pump end through priming cap immediately after use to prevent damage from freezing.

COLD WEATHER

RECOMMENDED PROCEDURE FOR COLD WEATHER OR PROLONGED STORAGE

The following procedure is recommended to ensure proper protection of the engine if the engine is to be left idle for prolonged periods between uses or if there is a possibility that the engine may be stored in an unheated area where freezing temperatures may occur.

- 1 With pump unit running at approximately low RPM (approx. 3-4 increment) V2 throttle, remove the quick-connect fuel line from the quick-connect fitting on the engine.
- 2 Allow engine to run until all fuel has left the carburetor and the engine stops.
- 3 Remove spark plug.
- 4 Rotate crankshaft until piston is at top dead centre.
- 5 Pour 30 ml (1 oz) of oil into spark plug opening (use same oil grade used in fuel mixture).
- 6 Rotate crankshaft 2 or 3 times to assure that cylinder walls are well coated with oil, then bring piston to top dead centre.
- 7 Reinstall spark plug.

It is preferable to keep the pump unit in dry storage above freezing temperature. However, as this is not always possible, some slight rusting may occur, which should have no detrimental effect on the life or performance of the unit.

TROUBLESHOOTING CHART

ENGINE DOES NOT START OR STARTS MOMENTARILY THEN STOPS

Possible cause	Remedy
Fuel supply tank empty	Refill fuel tank
Fuel supply valve closed	Open supply valve
Air vent on fuel tank closed	Open air vent or unscrew cap
Defective fuel supply hose	Replace
Dirty fuel strainer screen	Clean or replace
Leak in fuel supply system	Tighten or replace fittings
Carburetor mountings loose	Tighten mountings
Water or dirt in fuel system	Drain; flush thoroughly
Engine flooded	See "Flooding"
Too much oil in fuel mixture	See "Engine Lubrication and Fuel"
Spark plug fouled or defective	Clean or replace
No spark	See "Service Manual"

ENGINE RUNS IRREGULARLY OR MISSES

Possible cause	Remedy
Defective fuel supply hose	Replace
Dirty fuel strainer screen	Clean and replace
Leak in fuel supply system	Tighten or replace fittings
Carburetor mountings loose	Tighten mountings
Water or dirt in fuel system	Drain; flush thoroughly
Wrong gasoline in fuel mixture	See "Engine Lubrication and Fuel"
Too much oil in fuel mixture	See "Engine Lubrication and Fuel"
Air filter dirty	Clean or replace
Idle mixture screw misadjusted	See "Service Manual"
Spark plug fouled or defective	Clean or replace
Wrong type spark plug	Use plug recommended
Improper timing	Refer to timing section

ENGINE BACKFIRES

Possible cause	Remedy
Spark plug fouled or defective	Clean or replace
Defective carburetor	Replace
Improper timing	Refer to timing section

ENGINE DOES NOT IDLE PROPERLY

Possible cause	Remedy
Carburetor mountings loose	Tighten mountings
Too much oil in fuel mixture	See "Engine Lubrication and Fuel"
Idle mixture screw misadjusted	See "Service Manual"
Spark plug fouled or defective	Clean or replace
Wrong type spark plug	Use plug recommended
Main adjustment screw misadjusted	See "Service Manual"
Improper timing	Refer to timing section

ENGINE DOES NOT DEVELOP NORMAL POWER AND/OR OVERHEATS

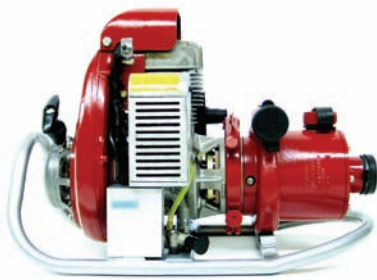
Possible cause	Remedy
Carburetor mountings loose	Tighten mountings
Wrong gasoline in fuel mixture	See "Engine Lubrication and Fuel"
Wrong oil in fuel mixture	See "Engine Lubrication and Fuel"
Not enough oil in fuel mixture	See "Engine Lubrication and Fuel"
Too much oil in fuel mixture	See "Engine Lubrication and Fuel"
Air filter dirty	Replace
Spark plug fouled or defective	Clean or replace
Wrong type spark plug	Use plug recommended
Cooling system dirty	See "Service Manual"
Muffler blocked or dirty	Replace
Main adjustment screw misadjusted	See "Service Manual"
Improper timing	Refer to timing section

ENGINE SOUNDS LIKE A FOUR STROKE

Possible cause	Remedy
Too much oil in fuel mixture	See "Engine Lubrication and Fuel"
Engine not warmed up properly	Allow longer warm up period
Main adjustment screw misadjusted	See "Service Manual"
Air filter dirty	Clean or replace
Improper timing	Refer to timing section

Refer also to section on "Servicing Carburetor" in Service Manual for additional "Trouble Data" and service information.





A more efficient and maintenance free electronic ignition system.



The electronic ignition allows for a smoother and more responsive engine run.

ELECTRONIC IGNITION

Since the introduction of the **MARK-3** fire pump into the industry, the **MARK-3** utilized breaker points in its ignition system, which inherently required maintenance; i.e. the gap adjustment, points cleaned and/or completely changed.

The upgrade to the electronic ignition system will eliminate the need for regular maintenance associated with breaker points. The electronic ignition system uses a magnetic pickup located on the flywheel, which when passing over a certain point on the stator will induce a high voltage, therefore causing the spark plug to fire at the proper moment.

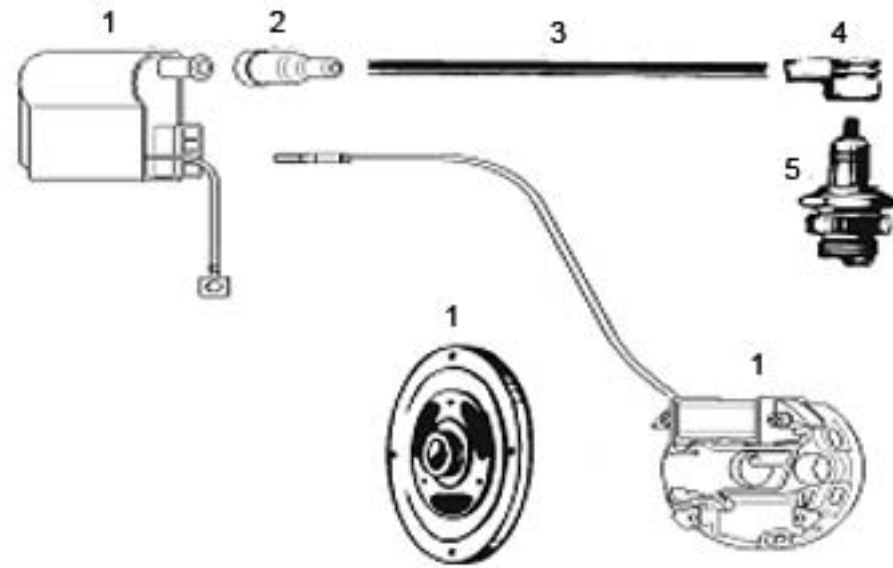
The electronic ignition module is equipped with spark advance, thus allowing for a cleaner burn at a higher RPM. During testing it was found that the engine ran smoother and was much more responsive. When the engine is started cold, it runs rough (as if the timing were off) for about 15-30 seconds, after which the engine runs smooth.

In order to convert a **MARK-3** from breaker points to the upgraded electronic ignition system, the following retrofit kit was created: B-7595 **MARK-3** Conversion kit, point to CDI.

The ignition cable is larger in diameter than the previous one used on the **MARK-3** with breaker points.

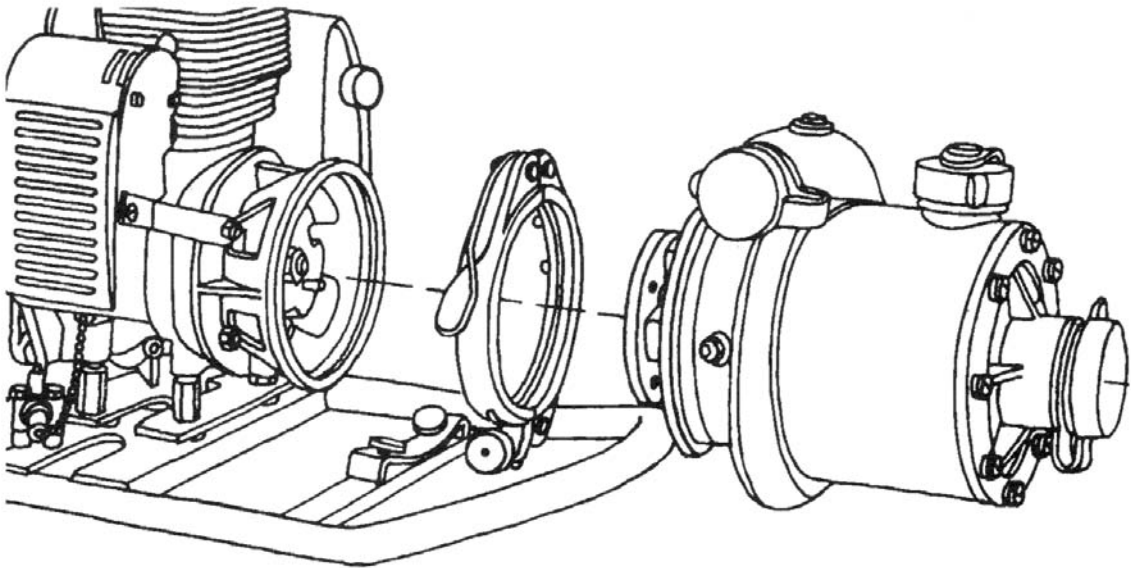
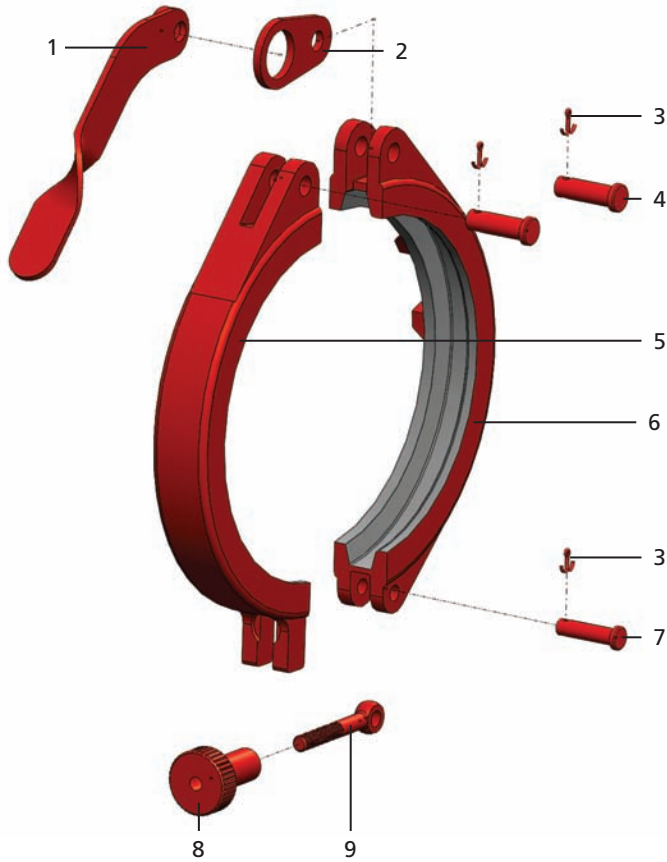
The breakdown of the electronic ignition is depicted in the picture to the left. The electronic module is placed in an aluminium box located on the frame below the carburetor shroud.

Ref. #	Description	Quantity
-	B-7595 Mark-3 conv. Kit point to CD (Includes all parts with *)	
-	A-7589 Mounting block/elect. Ignition (not shown)	1
1	R-271 Electronic ignition *	1
2	R-275 Protection cap *	1
3	R-274 Ignition cable *	1
4	R-650 Spark plug connector *	1
5	R-629 Spark plug	1



PUMP OPERATING AND LUBRICATION

Ref.	Part #	Description	Qty
-	212-170P	Clamp assembly (includes all the parts listed below)	1
1	A-4460	Lever, zinc plated	1
2	A-4452	Side link for lever	1
3	C-4462-5	Cotter pin	3
4	A-4455	Clevis pin for lever side	2
5	B-4461	Clamp - top half	1
6	B-4457	Clamp - bottom half	1
7	A-4454	Clevis pin for eye-bolt side	1
8	A-4456	Knob for tension adjustment	1
9	A-4453	Eye-bolt	1



PUMP LUBRICATION

The pump bearing must be greased every 8 hours of operation.

Use a clean grease gun filled with fresh grease. Remove dirt from grease fitting before applying grease gun. Grease should be pumped slowly into grease zerk while rotating the pump shaft. Continue pumping until fresh grease appears around bearing ring. Wipe off excess grease.

Do not use graphite grease or a pressurized grease gun.

TO REMOVE PUMP FROM ENGINE:

- 1 Lift pump clamp lever.
- 2 Release tension adjusting knob at bottom of clamp.
- 3 Remove clamp.
- 4 Remove pump from engine.

TO DRAIN PUMP:

It is recommended that the pump be drained after usage. This is a MUST during cold weather, to prevent damage to pump, due to freezing.

- 1 Remove discharge hose, suction hose and priming cap.
- 2 Drain pump by tilting pump body several times.
- 3 Stand pump on suction nozzle end for several minutes to complete drainage.
- 4 Replace discharge, suction and priming caps.

TO ATTACH PUMP TO ENGINE:

- 1 Place flexible buffer coupling on engine coupling pins.
- 2 Align flexible buffer coupling holes to pump end coupling pins and install.
- 3 Attach pump clamp. Carefully align clamp positioning pins with flange stub.
- 4 Adjust tension knob located at bottom of clamp to obtain a light pressure on clamp link.

PUMP TEST KIT

TESTING PROCEDURE

The best way to check your pump unit is to make an actual performance test. A test kit consisting of pressure gauge, pressure gauge adaptor, 3 m (10') length of discharge hose, a nozzle and a calibrated set of nozzle tips, is available.

**COLD OPERATION**

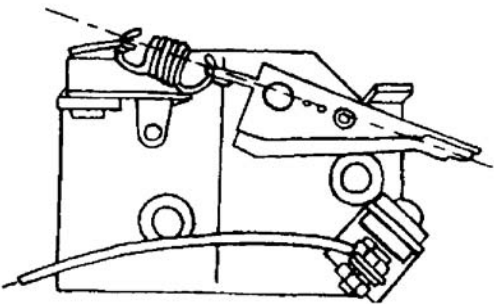
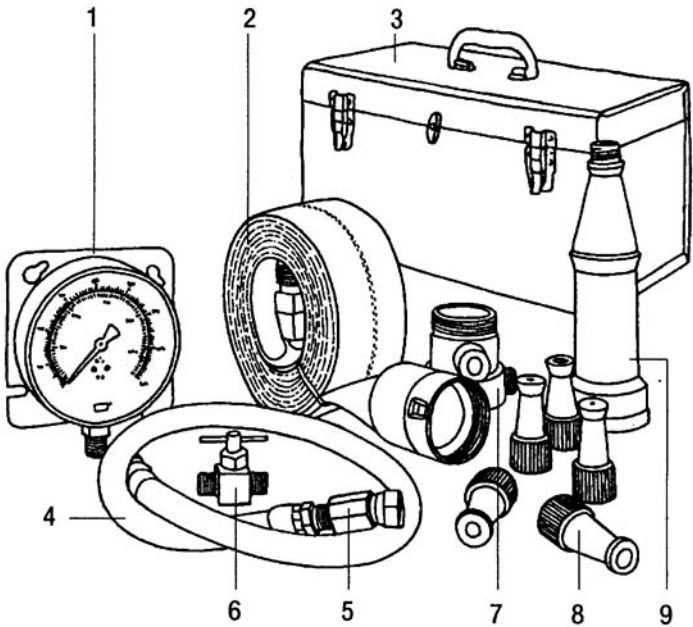
In cold operation it is good practice to put a small quantity of aluminum compatible antifreeze into pump end through priming cap immediately after use to prevent damage from freezing.

**IMPORTANT**

Apply FINGER PRESSURE ONLY to close pump clamp lever. Excessive pressure will damage or break clamp link.

Nozzle Size	1/2" 12,7 mm	7/16" 11 mm	3/8" 9,5 mm	5/16" 8 mm	1/4" 6 mm	1/8" 3 mm
Minimal Pressure	105 psi 724 kPa	145 psi 1000 kPa	180 psi 1241 kPa	225 psi 1551 kPa	265 psi 1827 kPa	320 psi 2206 kPa
Minimal Pressure Range	100-105 psi 689-724 kPa	125-130 psi 862-896 kPa	165-170 psi 1138-1172 kPa	210-215 psi 1448-1482 kPa	255-260 psi 1758-1793 kPa	315-320 psi, 2172-2206 kPa

Ref. #	Part #	Description	Qty
–	A-2388	Pump test kit (incl. al the parts listed below)	
1	A-2392	Pressure gauge 0-400 psi (0-2800 kPa), 4 1/2" (114 mm)	1
2	F5095E	Hose SPEC 187-1 1/2" X 10' w/brass coupling NPSH M/F F5095E00F10RBALFS	1
3	A-2389	Pump test kit box	1
4	A-2391	Rubber hose assembly (incl. a set of 2 adaptors A-2391B)	1
5	A-2391B	Adaptor Female NPT-Swivel Female	2
6	A-2390A	Shut-off valve	1
7	A-2390	Pressure gauge adaptor 1 1/2" (38mm) female NPSH to 1 1/2" (38mm) male NPSH	1
8	A-2395	Brass calibrated nozzle tip set: 1/8", 1/4", 5/16", 3/8", 7/16" (3mm, 6mm, 8mm, 9,5mm, 11mm)	1
9	C-1933	Calibrated nozzle, 1/2" (12,7mm)	1



**IMPORTANT**

Carburetor should be properly adjusted before starting performance test. See "Carburetor Adjustment". In addition the pump unit should be set up as close as possible to water source.

PUMP ADJUSTMENTS

OVERSPEEDING MAY OCCUR IF:

- 1 Pump not primed properly.
  - Suction hose and/or pump body not completely filled with water.
  - A bend in the suction hose, located higher than the pump suction inlet, causing an air lock. (The suction hose between the pump and water supply must have a downward slope.)
- 2 Loose suction hose coupling or priming cap.
- 3 Foot valve strainer clogged or too close to surface of water.
- 4 Pump loses prime.
  - Due to lack of water, air lock may form in the suction hose when pump unit works against a high delivery head. If this happens, disconnect the discharge hose from the pump then reprime pump in the normal manner.
  - Pump runs out of water, either because of lack of sufficient water supply or by attempting to pump water from a shallow water source.



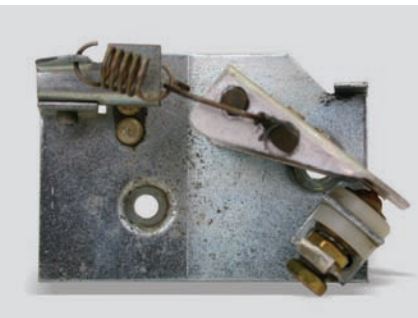
UPGRADED CUT-OUT SWITCH

MARK-3 UPGRADE OF THE B-6288 CUT-OUT SWITCH (The change in material of the air vane from Aluminium to Stainless Steel)

The aluminium air vane used on the B-6288 cut-out switch has been in service for many years with no complaints.

However, during harsh field testing, it was discovered that the air vane had deteriorated where the reset rod connects into the air vane. Intense vibrations would cause the reset rod to vibrate with respect to the air vane. This would in turn cause a hammering effect that would slowly enlarge the point of attachment of the reset rod to the air vane.

Therefore, it was decided to upgrade the material of the air vane from aluminium to stainless steel. This would inherently allow the air vane to last longer, thereby extending the life of the cut-out switch.



Shown with deterioration. Old style Alum. Air vane



New reinforced Stainless Steel Air vane. Stainless Steel for better durability.

The foot valve must remain at least 30 cm (1 foot) under the water surface while pump is operating.

All suction couplings, including foot valve, must be wrench tightened. Proper fitting gaskets must be used in all coupled joints. Worn or dried out gaskets should be replaced with new gaskets.

CUTOUT SWITCH ADJUSTMENT (STATIC)

The cutout switch must be adjusted when installed in the fan cowl. This is necessary because slight changes in the shape of the mounting plate occur when fastened in position on the fan cowl.

Check that, with the air vane in the approximate centre of its travel, the spring attachment holes "line up" with the pivot to form a straight line (see figure X). All brackets and pivot should be perpendicular with the face of the plate.

**Initial setting:** A preliminary setting can be made by placing on the vane an object sufficiently heavy to cause the vane to just leave the stop and start to move towards the contacting position. A 2.5 oz (70 g) weight is used to approximate the setting during assembly. The final calibration must be made with the engine running.

CUTOUT SWITCH ADJUSTMENT (DYNAMIC)

- 1 Setup pump unit close to water supply. Use a 2 m to 3 m (6' to 10') suction hose with foot valve attached. Connect a short length 2 m to 3 m (6' to 10') of discharge hose to pump outlet. Attach a calibrated nozzle having a 12,7 mm (1/2") diameter orifice.
- 2 After starting and warming up engine thoroughly, increase to maximum recommended power, then lift foot valve out of water supply. Engine will speed up then stop suddenly, indicating the automatic cutout switch is functioning.

Should the switch not cutout after 1-2 seconds, while engine is running at increased speed, close throttle and toggle switch immediately, otherwise serious engine damage may result.

Assuming that cutout is functioning, then the speed setting of the switch should be checked to make sure that it is not set too low or too high.

Use a reliable tachometer to check engine RPM.

- 3 Located in the upper centre of the outer surface of the fan housing, is a small socket head adjustment screw. By using a 1/16" Allen key (tool R-909) and turning this screw 1/2 turn clockwise will increase the cutout speed setting approximately 150 RPM. A 1/2 turn counterclockwise will decrease speed setting approximately 150 RPM. After each adjustment, recheck the actual speed at which cutout switch operates until proper setting is obtained.

If a reliable tachometer is not available, then the cutout switch may be roughly calibrated as follows:

Use a 3 mm (1/8") orifice tip screwed to nozzle. After warming up engine thoroughly, increase to full throttle, then turn adjustment screw slowly counterclockwise until switch cuts out and stops engine. Now turn screw one full turn clockwise and leave it in this position.

The cutout switch will now operate automatically to stop engine should pump run out of water, lose prime, etc. The switch will not interfere with normal operation of the unit and will also allow the use of small nozzle tips as well as complete pump shut-off for short periods of time.

MAINTENANCE CHECK LIST

Regular maintenance is a schedule of continuous systematic maintenance, designed to prevent frequent or major breakdowns before they occur.

Maintenance on a fire pump unit should not be done on the fire line. Always, check your pump unit immediately after use.

- 1 Clean unit thoroughly.
- 2 Clean air filter.
- 3 Clean fan housing and air intake screen.
- 4 Make sure cooling passages and cylinder fins are clean.
- 5 Make sure spark plug is cleaned and has proper gap setting.
- 6 Check stop switch for proper operation.
- 7 Check throttle and choke control for proper operation.
- 8 Make sure carburetor fuel strainer screen is clean.
- 9 Check fuel line and fittings for signs of wear, etc.
- 10 Check and grease pump end (as per instructions in previous section)
- 11 Check starter cable and mechanisms and replace if it shows signs of wear.
- 12 Check condition of buffer coupling.
- 13 Operate pump unit and check general performance. Adjust carburetor if necessary (see Service Manual for details)
- 14 Check carburetor adjustments.
- 15 Note any performance irregularities or any abnormal mechanical sounds.
- 16 Make sure pump seal is not leaking.
- 17 Make sure that all necessary tools, spares and accessories are with pump unit. It is strongly suggested to always have an extra spark plug on hand.
- 18 Make sure electronic ignition module is free of debris. Verify condition of wiring and connections.

Ref. ##	Part	Description	Qty
-	R-900	Maintenance tool kit (incl. all parts listed below)	1
1	Part-117	Grease gun	1
2	271-923	Wrench - adjustable 8" (203mm)	1
3	R-911M	Wrench - box & open end 1/2" (13mm)	1
4	R-906M	Wrench - box & open end 3/8" (10mm)	1
5	R-910	Wrench - open end 1/2"-9/16" (13-14mm)	1
6	R-902	Screwdriver 2" (51mm)	1
7	R-904	Wrench - spark plug	1
8	A-3023	Carburetor adjusting tool	1
9	R-901	Screwdriver, 4" (102mm) sq. handle	1
10	R-903	Feeler gauge - spark plug & breaker point	1
11	R-908	Wrench - open end 5 & 8mm (ignition)	2
12	R-905	Handle - rod	1
13	271-488	Bag - tool roll (not shown)	1
14	271-928	6 mm T-handle Hex 10.5" LG	1



SERVICING SPARK PLUG

Operating with a defective or incorrect spark plug will affect the engine's performance; hard starting, fouling, missing, overheating, pre ignition or lack of power. To service and inspect the spark plug, perform the following steps as required:

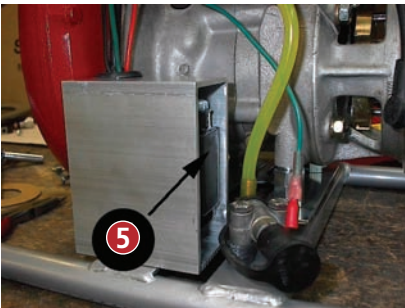
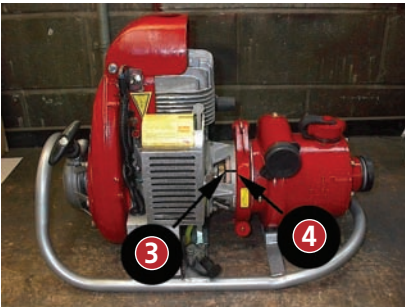
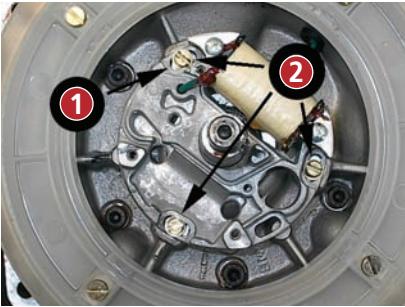
- 1 Remove spark plug cover.
- 2 Disconnect spark plug cable and remove spark plug.
- 3 Clean spark plug and inspect carefully. If tip of insulator core is rough, cracked, broken or blistered, or if electrodes are burned away to the extent that they are too thin and cannot be satisfactorily adjusted to recommended gap. 0.016" -0.020" (0.41-0.51mm), replace with new plug.

**IMPORTANT**

Refer also to section on "Servicing Carburetor" for additional "Trouble Data" and service information.

- Note:** Use R-629 spark plug.  
Use only spark plug type specified by engine manufacturer.
- 4 Reinstall spark plug. Start threads one or two turns with fingers to avoid danger of cross threading. Tighten spark plug to recommended torque of 25 Nm (18 ft-lbs or 215 inch-lbs).
  - 5 Connect spark plug cable.
  - 6 Install spark plug cover; tighten screws securely.

**Caution:** Ceramic insulation of spark plug is easily damaged by shock stresses or bending stresses as may be imposed by dropping, striking with hard objects or overtightening. Therefore, if spark plug has been subjected to such accidental abuse, it should be carefully inspected and tested before further use.

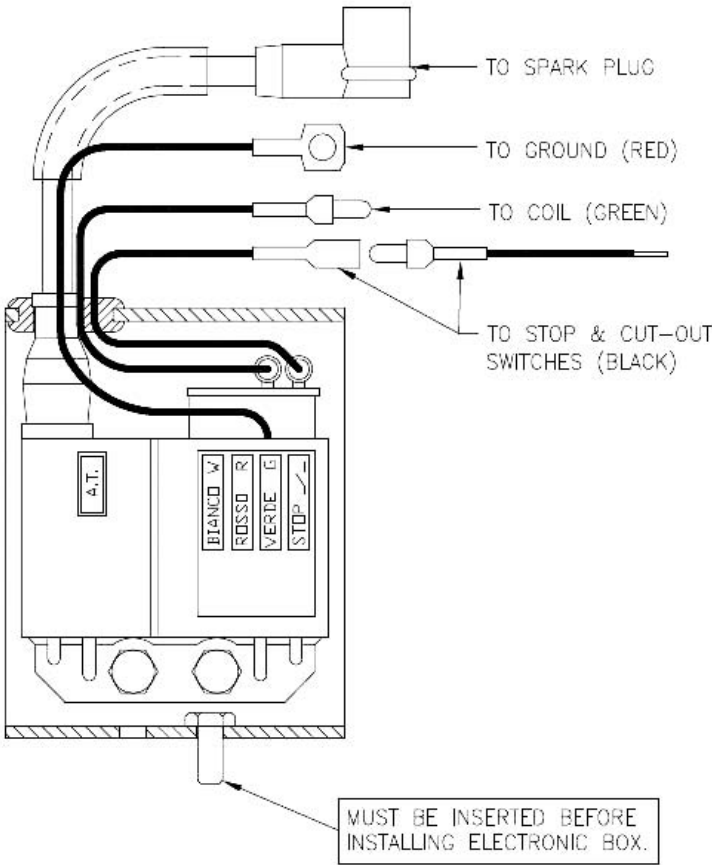


ELECTRONIC IGNITION UNIT

(Short explanation for retrofit installation of an electronic ignition unit on the MARK-3 engine which was originally fitted with contact breaker ignition)

PROCEDURE:

- Remove old flywheel and armature plate.
- Fit the new armature plate approximately centrally of the long holes 1, then turn it approx. 1 mm anti-clockwise, then tighten the 3 screws. 2
- Turn crankshaft until the piston is 3.75 mm before top dead centre, measuring through the spark plug hole with a dial gauge. For the final dynamical ignition timing check make an ink mark on the coupling buffer 12-17 3 as well as on the flange – pump mounting R-136. 4
- Fit electronic box. 5
- Start engine and check ignition timing with a stroboscopic lamp. The 2 marks 3 4 previously made must correspond at 3000 – 4000 r.p.m.
- If the 2 marks do not correspond, remove flywheel and loosen the 3 screws 2 of the armature plate, turn armature plate slightly in the direction needed. Repeat the procedure until the marks correspond.
- Seal rubber grommet 6 with Silastic.



**UPGRADED SPARK PLUG CAP**

For years the **MARK-3** has been using a rubber spark plug connector R-650. The rubber connector has been known to crack where the wire goes into the connector and where the rubber connector goes onto the spark plug.

The rubber connector was replaced with a new robust type of connector used on high performance recreational vehicles. The new connector has the added benefit of being able to shield against signals.

The part number will still remain the R-650.



A new robust type of connector will replace the old spark plug rubber cap.



ELECTRONIC IGNITION MODULE SETTINGS

Table	System	Part number
Resistance value Check	Ø116mm Flywheel magneto	492.19.6009
Resistance value Check	CDI unit with H.V. coil	432.39.9510

FLYWHEEL MAGNETO

+ / -	Green wire	Ground (stator)
Green wire	-	225 ÷ 255 Ω
Ground (stator)	225 ÷ 255 Ω	-

CDI UNIT WITH INTEGRATED IGNITION COIL

+ / - testing pin	STOP	VERDE (G)	Ground (red wire)	H.V. output (AT)
STOP	-	≤ 0.1 Ω	≥ 50 MΩ	≥ 50 MΩ
VERDE (G)	≤ 0.1 Ω	-	≥ 50 MΩ	≥ 50 MΩ
Ground	≥ 50 MΩ	≥ 50 MΩ	-	4.7 ÷ 5.5 KΩ
H.V. output.	≥ 50 MΩ	≥ 50 MΩ	4.7 ÷ 5.5 KΩ	-

Notes:

- Testing Temperature: 25° C.
- Values (in ohm) detected by Tester Digital BECKMAN RMS 3030.
- The above said values are not always a guarantee of perfect efficiency of the part.



DECOMPRESSION SWITCH R-233DS

The MARK-3 model MK-3-DS features a decompression switch that significantly facilitates starting the pump.

To convert existing Mark-3's, simply replace the cylinder head with an **R-233DS** (New cylinder head including a decompression switch assembly).

KEY CHARACTERISTICS

- Decompression switch makes easy pulling / starting of recoil starter on high compression **MARK-3**
- Engine fires up much easier
- No kick back
- Easily engaged, simply push decompression switch in
- Automatically disengages / closes when engine starts

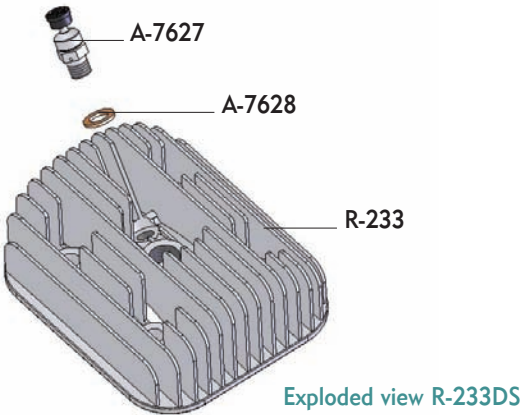
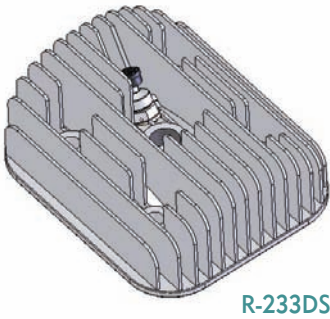
PARTS BREAKDOWN

- Decompression Switch: **A-7627**
- Copper Washer: **A-7628**
- Cylinder Head: **R-233** (machined head not sold separately)
- Head Gasket: **R-238** (not shown)

INSTALLATION NOTES

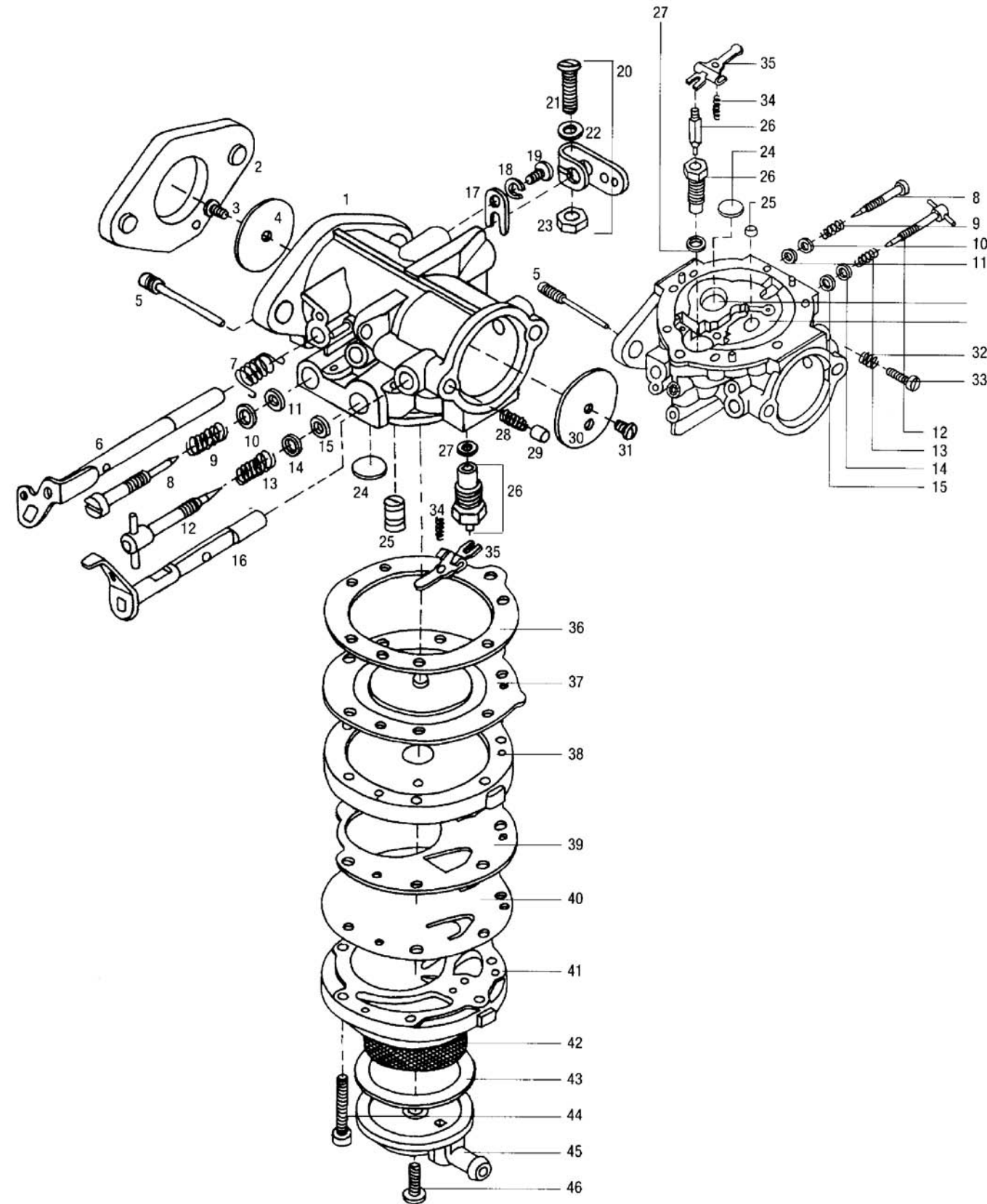
- Torque value for decompression switch: 190-210 in-lbs (21-24 Nm).
- Install cylinder head with decompression switch oriented towards pump end.

NOTE: Not yet available on MK-3-GSA version.



SERVICING CARBURETOR

CARBURETOR DESCRIPTION



Ref.#	Part#	Description
–	R-1115	Carburetor (includes parts listed below except R-1113)
1	R-1045	Body
2	R-1113	Gasket-carburetor
3	R-1041	Mach. screw with lockwasher
4	R-1040	Throttle shutter
5	R-1026	Inlet control lever pinion screw
6	R-1035	Throttle shaft and lever
7	R-1039	Throttle shaft return spring
8	R-1019	Idle mixture screw
9	R-1020	Idle mixture screw spring
10	R-1021	Flat washer, brass
11	R-1022	Idle mixture screw packing
12	R-1030	High speed mixture screw
13	R-1020	High speed mixture screw spring
14	R-1021	Flat washer, brass
15	R-1022	High speed mixture screw packing
16	R-1004	Choke shaft and lever
17	R-1036	Throttle shaft clip
18	R-1037	Lockwasher
19	R-1038	Mach. screw
20	R-1101	Throttle link lever assembly
21	R-1111	Bolt
22	R-1112	Flat washer
23	R-1110	Hex nut
24	R-1001	Body channel welch plug
25	R-1034	Nozzle check valve
26	R-1046N	Inlet needle and seat
27	R-1047	Inlet seat gasket
28	R-1003	Choke friction spring
29	R-1002	Choke friction pin
30	R-1005	Choke shutter
31	R-1041	Mach. screw with lockwasher
32	R-1024	Idle speed screw spring
33	R-1023	Idle speed screw
34	R-1029	Inlet tension spring
35	R-1025N	Inlet control lever
36	R-1008	Diaphragm gasket
37	R-1009	Diaphragm
38	R-1010	Diaphragm cover
39	R-1011	Fuel pump gasket
40	R-1012	Fuel pump diaphragm
41	R-1013	Fuel pump body
42	R-1015	Fuel strainer screen
43	R-1016	Fuel strainer cover gasket
44	R-1014	Mach. screw with lockwasher
45	R-1017	Fuel strainer cover
46	R-1018	Mach. screw
–	R-1050	Repair parts kit (includes parts R-1001, R-1008, R-1009, R-1113, R-1025N, R-1011, R-1012, R-1016, R-1046N, R-1046N-L)

The carburetor can be cleaned with a minimum of tools. Before disassembling carburetor it is **imperative** to flush it clean of dirt by using proper carburetor cleaner.

- 1 Remove strainer cover retaining screw and plastic cover.
- 2 Remove strainer cover gasket and strainer screen.
- 3 Remove screws and fuel pump body.
- 4 Remove fuel pump diaphragm and gasket.
- 5 Remove main diaphragm cover plate.
- 6 Remove main diaphragm and main diaphragm gasket.
- 7 Remove inlet control lever fulcrum pin, lever and tension spring.
- 8 Remove inlet needle.
- 9 With a thin wall 8 mm (5/16") hex socket carefully remove the inlet seat. Remove inlet seat gasket. When reinstalling seat, tighten only to 3 or 4 Nm (25-35 inch-lbs).
- 10 Remove idle and high speed mixture screws.
- 11 When reinstalling O-ring type adjusting screws, lubricate with SAE-30 oil to prevent seizing. Packing spring type adjustments do not require lubrication.
- 12 The ball check type main nozzle can be removed by tapping it out of the body casting into the venturi with a small punch. A replacement ball check nozzle should be pressed into the casting. The brass cage should be pressed flush with the metering chamber casting.

Before reassembling the carburetor (in reverse order as outlined above) wash **all** component parts in carburetor cleaner and blow off with compressed air. The channels in the metering body should be cleaned by blowing through the idle and main adjusting orifices. All fuel passages in the three castings should be cleaned with compressed air.

**Do not** clean orifices or passages with wires or drills as this might damage and cause incorrect operation of the carburetor.

When reassembling the inlet control lever and spring, make sure that the spring rests in the well of the metering body and locates on the dimple of the inlet control lever.

Do not stretch spring. Inlet control lever is properly set when flush with floor of diaphragm chamber.

Be certain main diaphragm, gasket and cover casting are carefully fitted over the three small pins cast in rim at bottom of metering body. Also the fuel pump gasket, diaphragm and fuel pump body are placed over similar pins at bottom rim of main diaphragm cover casting. Evenly tighten fuel pump body retaining screws to insure complete seal of casting separations at both diaphragms.

Frequent cleaning or replacement of the fuel strainer screen will aid satisfactory operation of the carburetor.



SERVICING CARBURETOR (CONTINUED)

CARBURETOR ADJUSTMENT

The carburetor is provided with three adjustments, namely high speed (main) adjustment; low speed (idle) adjustment; and idle speed regulating screw.

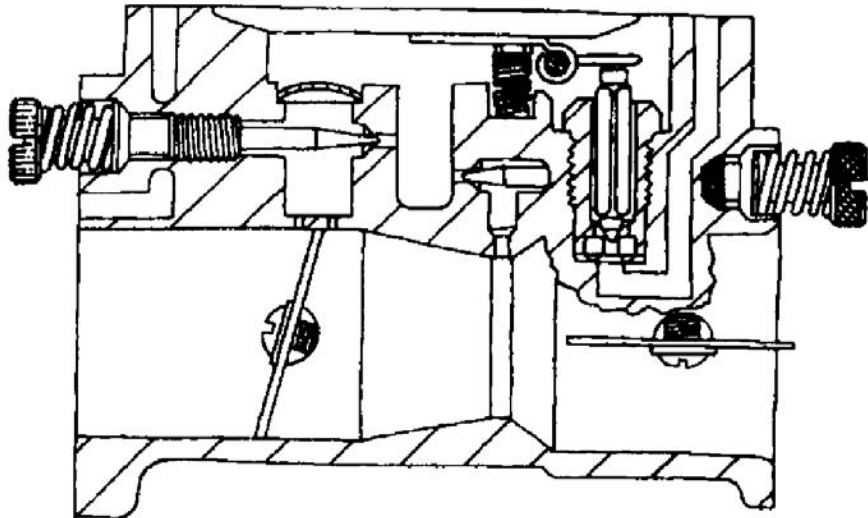
- 1 Before starting pump unit, close both main and idle adjustment screws, by turning clockwise, until needle just touches seat.

**Note:** Turn adjustment screws carefully and gently. Do not force needle into seat, otherwise, both needle and seat may be permanently damaged.

- 2 Open main adjustment screw 1 turn, by turning counterclockwise.
- 3 Open idle adjustment screw 1 turn, by turning counterclockwise.
- 4 Turn idle speed regulating screw until throttle shutter is slightly open.
- 5 Start unit. Open choke slowly, and allow engine to warm up thoroughly, gradually increasing speed to full throttle setting while running with 6 mm (1/4") diameter nozzle tip connected to a 3 m (10') discharge hose.
- 6 When engine is thoroughly warmed up, close throttle, then adjust idle adjustment screw and idle speed regulating screw, until engine idles smoothly between 2000-2200 RPM.
- 7 Increase speed gradually to full throttle setting, then turn main adjustment screw until engine gives maximum RPM and pump delivers maximum pressure. Then, turn main adjustment screw 1/4 turn maximum counterclockwise. This setting will give correct mixture ratio to assure proper engine lubrication.

**Do not** leave main adjustment screw set too lean, otherwise serious engine damage may occur due to lack of sufficient lubrication.

**Note:** It will be necessary to readjust the carburator when taking the pump from one altitude and placing in a different altitude. Repeat step 1 to 7.



CARBURETOR TROUBLE CHART

CARBURETOR FLOODING

Possible cause	Remedy
Dirt or foreign particles preventing inlet needle from seating.	Remove, clean and replace.
Diaphragm lever spring not seated on lever dimple.	Remove lever and reinstall.
Diaphragm improperly installed in carburetor.	Replace diaphragm or correct installation.
Improper use of choke	Proper use of choke at start-up

ENGINE WILL NOT ACCELERATE

Possible cause	Remedy
Idle adjusting screw set too lean.	Enrich idle adjustment.
Incorrect setting on diaphragm lever.	Reset.
Diaphragm cover plate loose.	Tighten.
Diaphragm gasket leaking.	Replace.
Main fuel orifice plugged.	Remove diaphragm cover, diaphragm, diaphragm lever and main adjusting screw. Clean out orifice by blowing through main adjustment threaded hole.

ENGINE WILL NOT IDLE

Possible cause	Remedy
Incorrect idle adjustment.	Reset to best idle.
Idle discharge ports or channels clogged.	Blow out with compressed air, or if compressed air is not available, clean and flush with gasoline.
Diaphragm lever set incorrectly.	Reset diaphragm lever so it is flush with the floor of the diaphragm chamber.
Throttle shutter cocked in the throttle bore causing fast idle.	Reset.
Dirty nozzle check valve.	Clean and/or replace.
Welch plug covering the idle discharge ports does not seal. This causes the engine to idle with idle adjustment shut off.	Replace welch plug, following instructions outlined in service manual.

ENGINE RUNS OUT LEAN

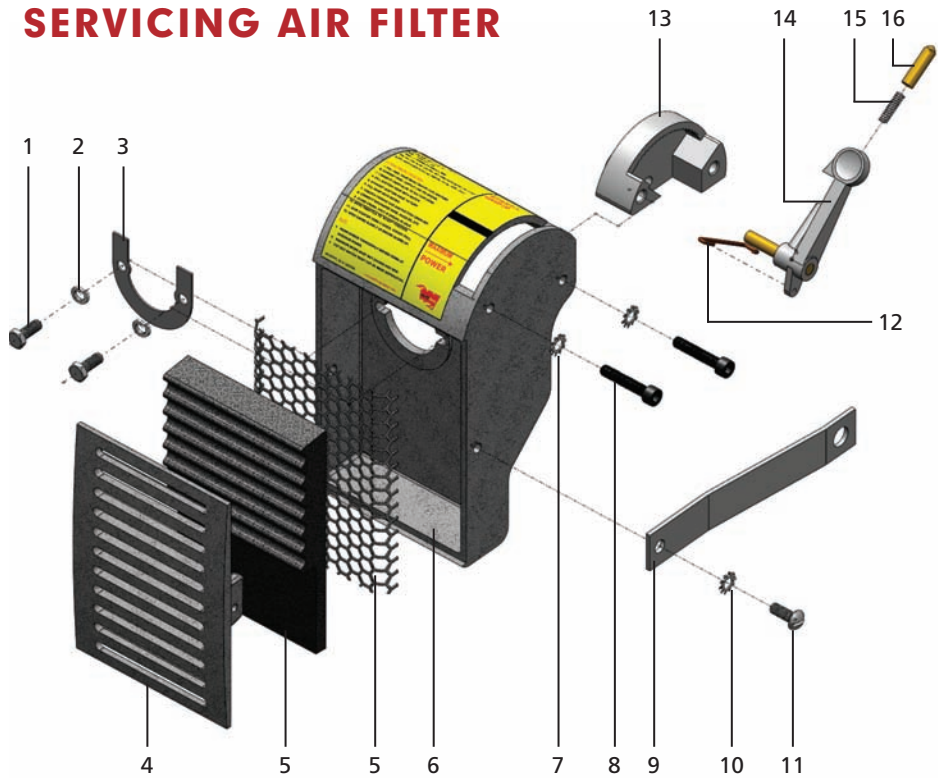
Possible cause	Remedy
Tank vent not working properly.	Clean and/or replace.
Leak in fuel system from tank to pump.	Tighten or replace fittings or lines.
Ruptured fuel pump diaphragm.	Replace.
Main fuel orifice plugged.	Clean.

CARBURETOR RUNS RICH WITH MAIN ADJUSTMENT SHUT OFF

Possible cause	Remedy
The nozzle channel plug, or nozzle check valve cage, is not sealing.	Install new plug or new cage.

Ref. #	Part #	Description	Qty
--	R-792	Throttle control assembly (includes all parts with *, 7 items)	1
1	R-793	Mach. screw hex cap, Nylock	2
2	R-791	Lockwasher	2
3	R-1044	Lock plate	1
4	R-794	Cover for air filter	1
5	R-955	Air filter element - foam & screen (option R-795 also available)	1
6	R-790	Carburetor shroud (includes decal A-4030)	1
7	12-79	Lockwasher, star type	2
8	B-4036-12*	Mach. screw hex socket	2
9	R-799	Bracket	1
10	12-79*	Lockwasher, star type	2
11	R-774	Mach. screw	2
12	R-1102*	Link for throttle	1
13	B-4024*	Quadrant for throttle lever	1
14	R-1107*	Throttle lever sub-assembly	1
15	A-4028*	Spring	1
16	A-4027*	Pin - index	1
--	MTR-1000	Hours meter with RPM (not shown)	1

SERVICING AIR FILTER

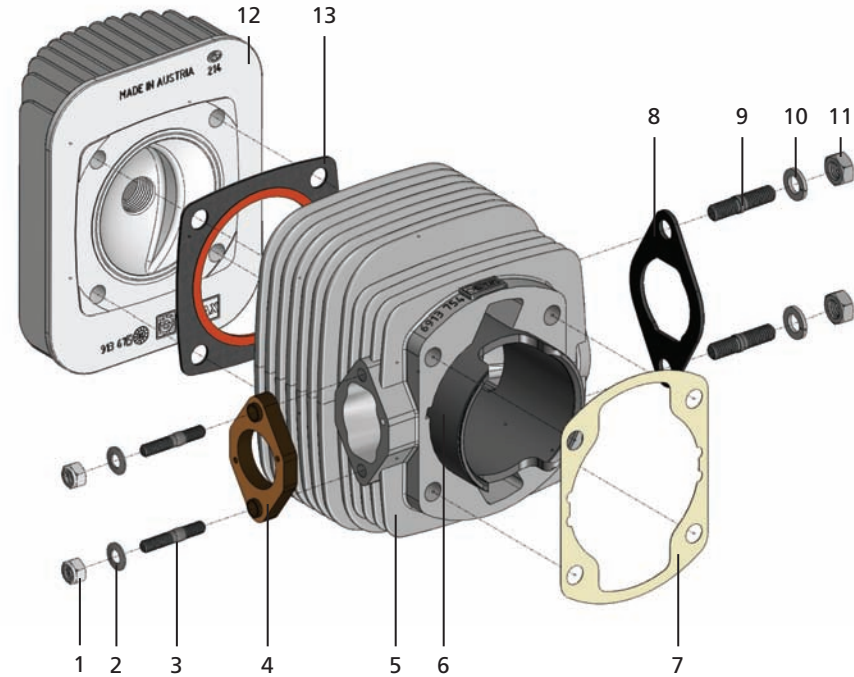


If not cleaned regularly, the filter element will become clogged and will seriously restrict airflow to the carburetor.

This restriction will cause engine to run irregularly, lose power and four-stroking will develop due to an over-rich mixture entering the carburetor.

Therefore, whenever the filter element becomes dirty, or whenever any of the above conditions occur, remove the filter element and wash it in a appropriate cleaning solution. Apply 2-cycle oil to filter element and squeeze to distribute oil evenly. Reinstall filter and screen into housing and install cover. When the filter will not wash clean or is damaged, replace it.

Ref. #	Part #	Description	Qty
1	R-150	Hex lock nut	2
2	R-149	Lockwasher	2
3	R-402	Stud	2
4	R-1113	Gasket -carburetor	1
5	R-257	Cylinder	1
6	R-270	Cast iron sleeve	1
7	R-235	Gasket -cylinder flange	1
8	R-237	Gasket -muffler	1
9	R-117	Stud	2
10	R-119	Lockwasher	2
11	R-120	Hex nut	2
12	R-233	Cylinder head - 18mm	1
13	R-238	Gasket -cylinder head	1



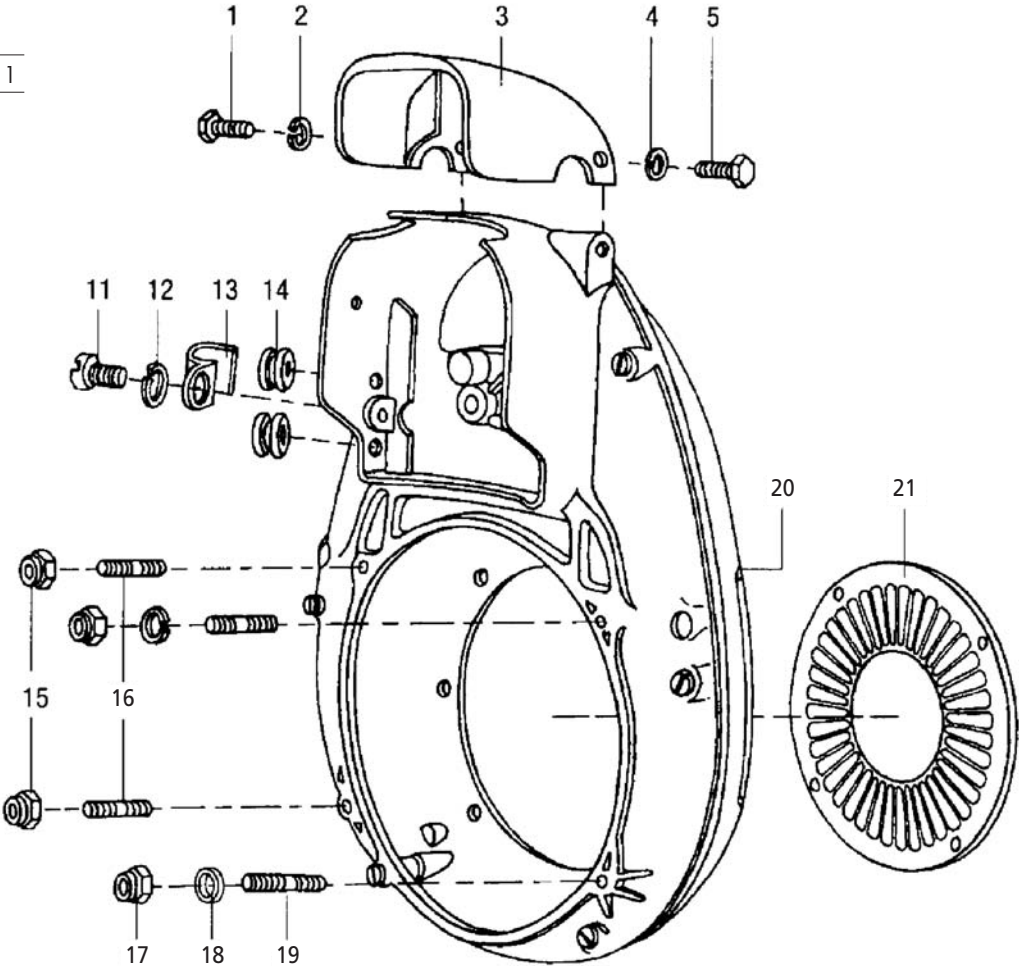
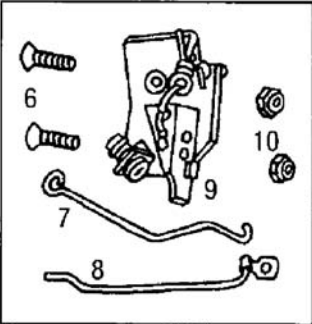
Ref. #	Part #	Description	Qty
1	R-414	Mach. Screw hex cap	1
2	R-119	Lockwasher	1
3	R-413	Cover for spark plug	1
4	R-119	Lockwasher	1
5	R-414	Mach. Screw hex cap	1
6	B-2920-6	Flat slotted bolt	2
7	A-2924	Reset rod	1
8	A-2926	Cable	1
9	B-6288	Cutout switch assembly (includes ref. #6, #7, #8, #10 and #14)	2
10	B-2428-6	Hex lock nut	2
11	R-408	Mach. Screw	1
12	12-38	Lockwasher	4
13	R-409	Clamp - ignition cable	1
14	B-2920-23	Grommet	2
15	TY-1811	Hex nut	3x
16	R-115	Stud	3
17	R-150	Hex lock nut	2x
18	R-151	Flat washer	1
19	R-402	Stud	1
20	R-411P	Fan cowl with studs, painted (includes R-115 and R-402)	1
21	R-418	Shield - fan	1

SERVICING COOLING SYSTEM

Efficient engine cooling is accomplished by a fan attached to the flywheel. This fan pulls air through the fan housing screen, then forces the air around the cylinder and through the spaces between the cylinder and cylinder head fins.

In time, the cooling air passages will become partially clogged and fins will become coated with dirt, therefore reducing the cooling efficiency.

Therefore, whenever this condition occurs, remove fan housing, then use compressed air or a stiff bristle brush and appropriate cleaning solution to remove all dirt deposits from fins and from inside the fan housing.

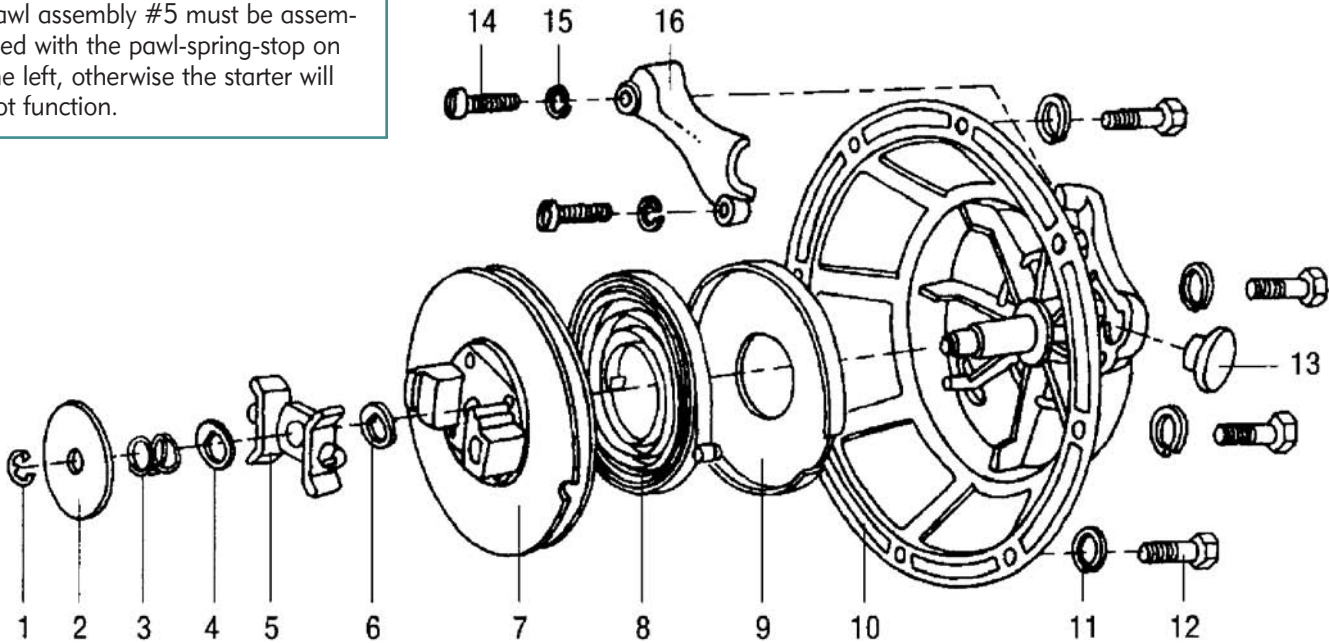




Ref. #	Part #	Description	Qty
-	R-529	Rewind Starter (includes all parts listed below)	1
1	R-518	Circlip	1
2	R-517	Flat Washer	1
3	R-516	Spring - friction	1
4	R-526	Washer - Friction	1
5	R-528	Pawl assembly	1
6	R-510	Flat "D" washer	1
7	R-504	Aluminum sheave starter rope	1
8	R-506	Spring - rewind	1
9	R-531	Retainer - spring	1
10	R-530	Housing - starter (includes R-531)	1
11	12-38	Lockwasher	4
12	R-522	Mach. screw hex cap	4
13	R-509	Plug - rubber	1
14	R-524	Mach. Screw	2
15	R-523	Lockwasher	2
16	R-532	Cover	1
17	R-505	Pin - starter rope lock	1
18	R-533	Guide - starter rope	1
19	R-502	Rope - starter	1
20	R-544	Buffer - rubber	1
21	R-501	Handle - starter rope	1

**NOTE**

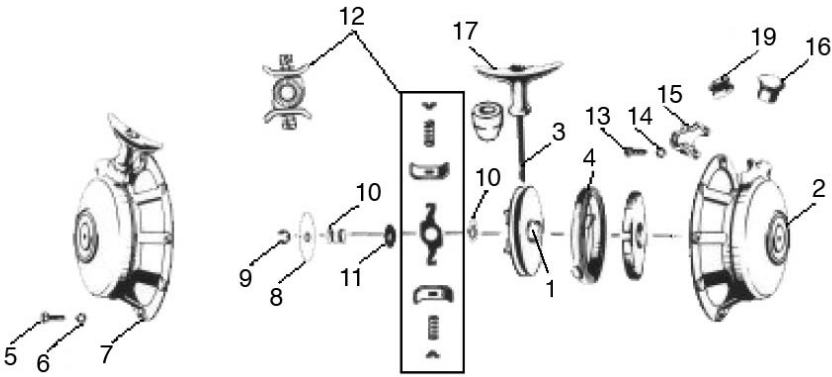
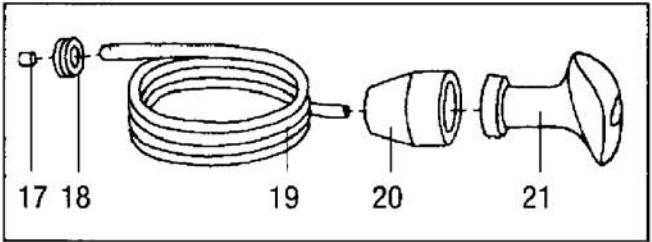
Pawl assembly #5 must be assembled with the pawl-spring-stop on the left, otherwise the starter will not function.



SERVICING THE REWIND STARTER

Starter proceed as follows:

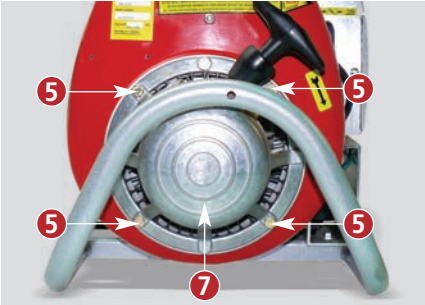
1. Remove four bolts #12 and four lock washers #11.
2. While holding rope sheave #7 in place to prevent sudden rotation of the sheave, remove handle #21 and rubber buffer #20.
3. Allow sheave to rotate slowly until spring tension is completely relaxed.
4. Remove two screws #14, two lock washers #15, cover #16, lock pin #17 and guide #18.
5. Remove circlip #1 and then remove items #2, 3, 4, 5 and 6 from starter housing.
6. If friction washers #4 and #6 are worn, replace them.
7. If pawls are broken or worn, replace the complete pawl assembly #5.
8. Very carefully remove rope sheave, making sure the rewind spring #8 remains in the retainer #9 and the starter housing #10. Always wear eye protection when removing the rope sheave.
9. Very carefully remove rewind spring. Always wear gloves and eye protection when removing the rewind spring.
10. Wash all metal parts with proper cleaning solution.



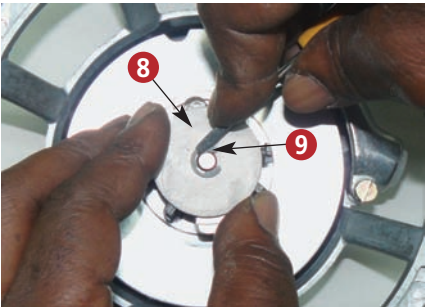
REMOVAL OF REWIND STARTER:

**Warning:** All repairs must to be carried out by qualified, professionally trained and authorized staff. Only careful assembly and respecting all the instructions of this SERVICE INFORMATION will warrant trouble free operation.

- Remove 4 hex. screws M6x20 **5** with lock washers (6) and detach the rewind starter ass'y. **7**



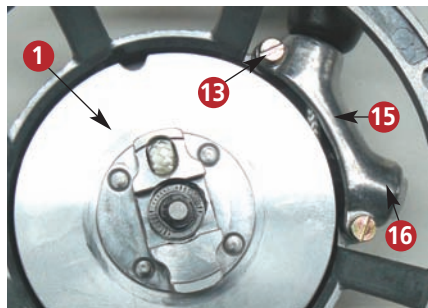
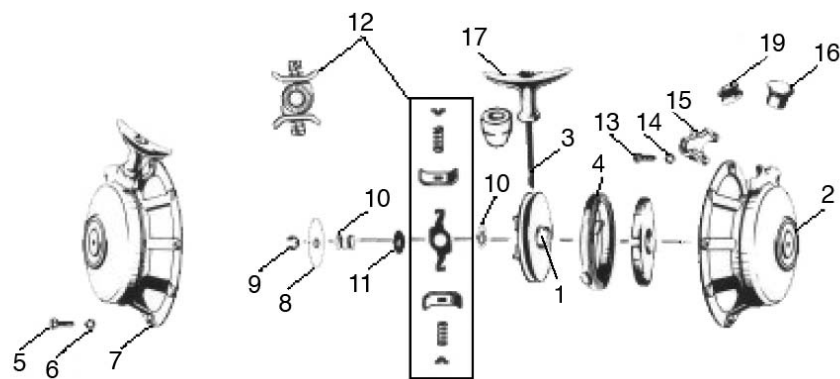
- Depress the cover washer **8** and remove circlip **9**.



- Remove cover washer **8**, friction spring **10** and friction washer **11**.
- Remove rewind starter parts set ass'y **12** and thrust washer.



## SERVICING THE REWIND STARTER (CONTINUED)

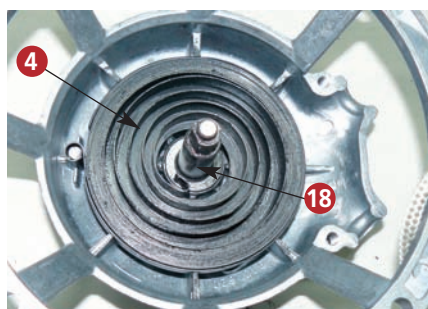


- Hold rope sheave **1** and remove the 2 Allen screws M5x16 **13** along with lock washers **14** and the cover **15** with plug **16**.

**Warning:** Keep rope sheave **1** firmly in hands! Risk of injury when rewind spring **4** unwinds!

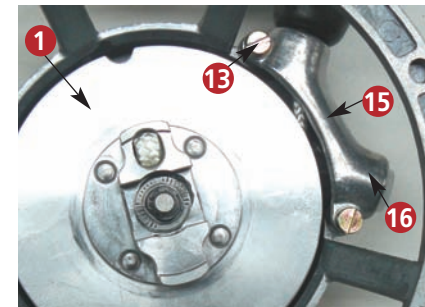
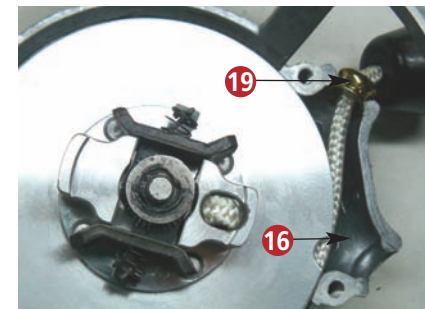


- Pass the starter grip **17** through the window in the starter housing and turn rope sheave **1** approx. 4 turns counterclockwise so that the rewind spring **4** unwinds.
- Remove starter sheave **1** with starter rope **3** and starter grip **17**.



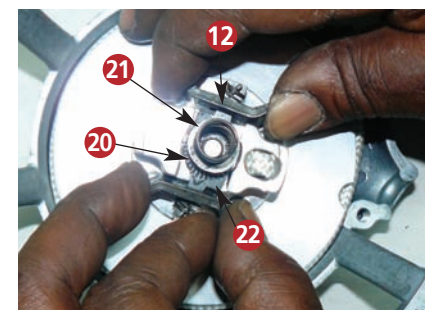
- Check bearing bolt **18** for signs of seizure.
- Note:** If there are slight signs of seizure remove them carefully.
- Check bearing bore of the rope sheave **1** for signs of seizure.
- Note:** If there are signs of seizure the rope sheave must be replaced.
- Apply oil on the rewind spring **4**.
  - Apply Molykote G-N slide paste on the bearing bolt **18** of the rope sheave **1**.

## REASSEMBLY OF REWIND STARTER:



- Wind starter rope **3** fitted with starter grip **17** counter-clockwise in the rope sheave **1**.
- Fit rope sheave **1** on the bearing bolt and engage it by slight turning into the rewind spring **4**.
- Hold rope sheave firmly and turn starter housing 4 turns clockwise to pre-tension the rewind spring.
- Fit rope guide **19** in the recess and pass the starter grip through the window in the starter housing, holding the rope sheave firmly.
- Fit the plug **16**.
- Fit the cover **15** and fix it with 2 Allen screws M5x16 **13** and lock washers **16**.

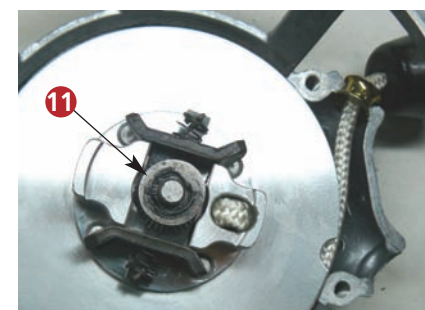
**Tightening torque:** 2.2 - 3 lb-ft (3 - 4 Nm)



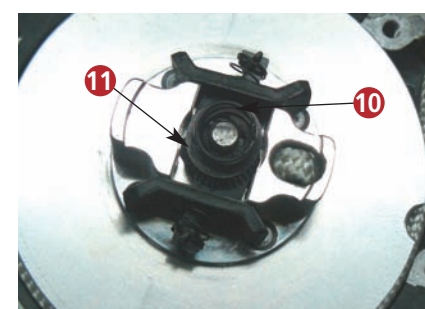
- Insert thrust washer **10**.
- Fit rewind starter parts set ass'y **12** in the rewind starter.

**Note:** Pay attention to correct positioning. The corners of the pivot arm **20** must point toward top / left **21** and down / right **22**.

- Slightly lubricate the serration **20** of the pivot arm.



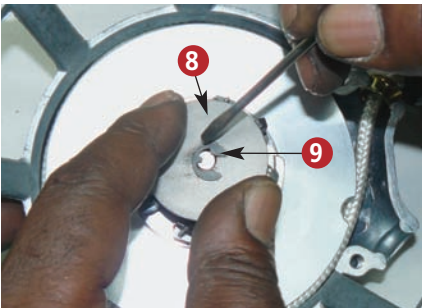
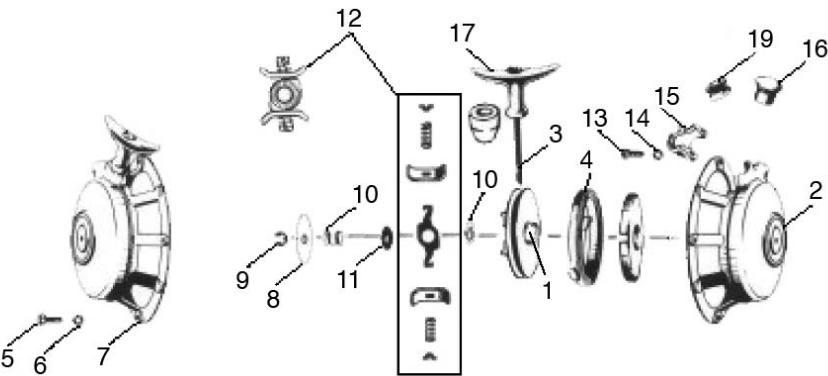
- Insert the friction washer **11** so that the serration points towards pivot arm **20**.



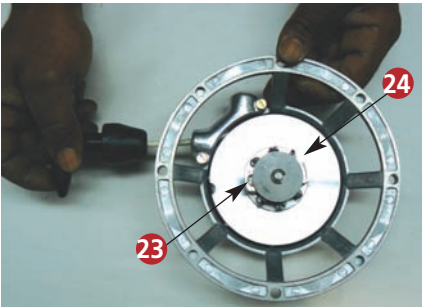
- Fit friction spring **10** and cover washer **8**.



SERVICING THE REWIND STARTER (CONTINUED)

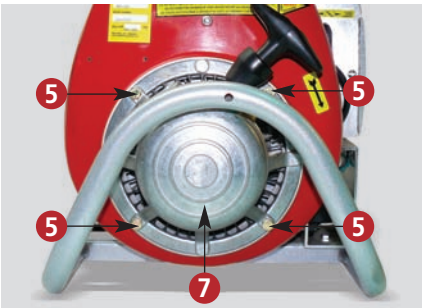


- Depress cover washer **8** and fit circlip **9**.



- Pull starter grip **17** and check whether the pawls **23** **24** are moving outward. When releasing the starter grip the starter rope must be rewound to its idle position.

**Note:** If the pawls do not move outward the rewind starter parts set ass'y **12** has been inserted wrongly. In this case disassemble it again and fit the rewind starter parts set ass'y **12** correctly.



- Fit rewind starter ass'y **7** with 4 hex. Screws M6x20 **5** and lock washers **6**.

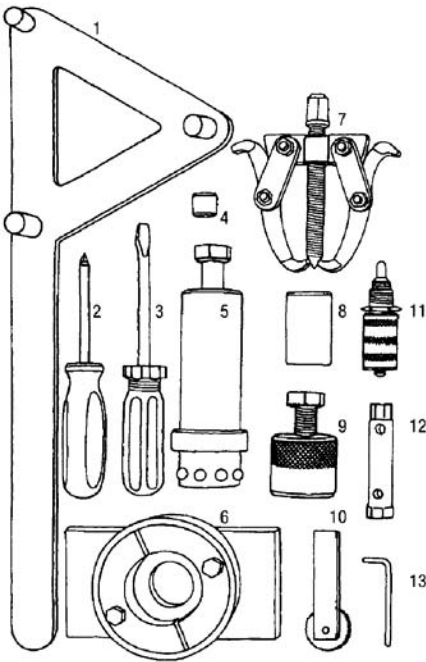
**Tightening torque: 6.6 lb-ft (9 Nm)**

- Start engine to check function of the rewind starter.

SERVICING MAGNETO

To check if ignition system is functioning, remove spark plug and connect another spark plug, with gap set to 3,2 mm (0.126"), to the ignition cable. With this plug resting on top of cylinder head, give starter rope a normal pull. Spark should easily jump the gap, if system is functioning properly.

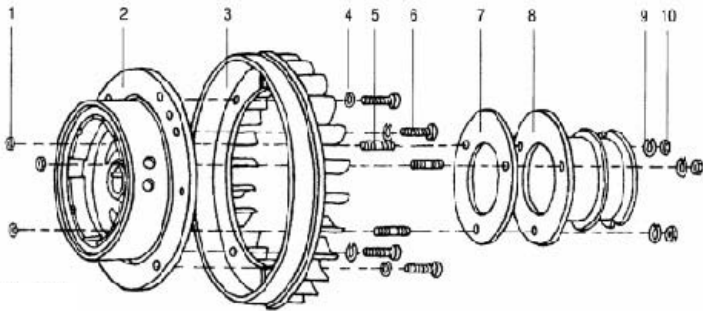
If no spark appears:		If spark is weak:	
Check stop switch and cable for possible short		Check magneto air gap	
Check for shorted condenser		Check electronic ignition module	
Check for open coil			
Check for broken leads or cables			
Check electronic ignition module			



Ref. #	Part #	Description	Qty
-	R-952	Service tool kit (incl. all parts listed below)	1
1	R-929	Flywheel holding tool	1
2	271-927	Screwdriver Phillips No.12	1
3	271-346	Screwdriver - standard	1
4	R-928	Cap - shaft protector	1
5	R-930	Puller - crankshaft bearing R-313	1
6	R-938	Puller - crankshaft bearing R-333	1
7	R-932	Puller - collar coupling	1
8	R-933	Oil seal - pressing tool	1
9	R-927	Puller - magneto	1
10	R-953	Crankshaft jack	1
11	R-954-14	Gauge - timing	1
12	R-926	Socket wrench 14mm (9/16")	1
13	R-909	Key - Allen 2,4 mm (3/32")	1

Ref. #	Part #	Description	Qty
1	R-116	Hex lock nut	3
2	R-667N-E*	Flywheel magneto assembly	1
3	R-603	Fan (included in R-667N-E)	1
4	R-791	Lockwasher	4
5	R-602	Stud	3
6	R-146	Mach. screw	4
7	R-653	Gasket	1
8	R-601	Pulley manual starter rope	1
9	12-38	Lockwasher	3
10	R-116	Hex lock nut	3

\*New models do not have a dust shield R-647.

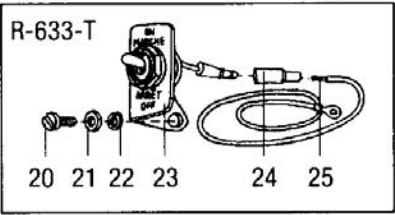
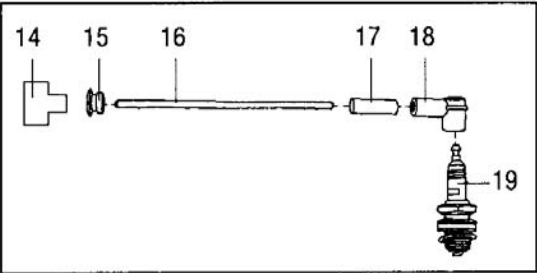
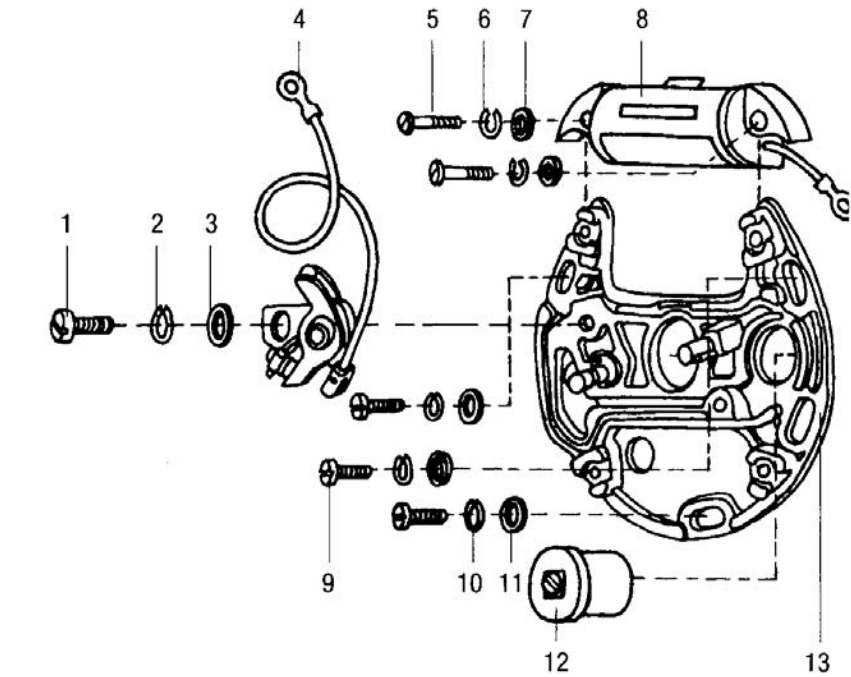


Ref. #	Part #	Description	Qty
-	R-656	Armature plate complete (incl. parts with *)	1
1	R-665*	Mach. screw	1
2	R-661*	Lockwasher	1
3	R-617*	Flat washer	1
4	R-664*	Point & cable condenser R-628	1
5	R-612*	Mach. screw	2
6	R-611*	Lockwasher	2
7	R-637*	Flat washer	2
8	R-661*	Coil	1
9	R-638	Mach. screw	3
10	R-611*	Lockwasher	3
11	R-637	Flat washer	3
12	R-662*	Condenser	1
13	R-659	Armature plate (incl. R-662)	1
14	R-654*	Cap	1
15	R-636*	Grommet	
16	R-630*	Cable-spark plug	1
		Cable- spark plug	
17	R-645	Rubber sleeve	1
18	R-650	Protector - spark plug	1
19	R-629	Spark plug 18mm	1
-	R-633-T	Stop switch kit (incl. Ref. #20 to #25)	1
20	R-665	Mach. screw	1
21	R-637	Flat washer	1
22	R-611	Lockwasher	1
23	C-7010-12	Stop switch assembly	1
24	C-7010-12C	Stop switch assembly	1
25	R-634*	Cable stop switch	1

SERVICING MAGNETO (CONTINUED)

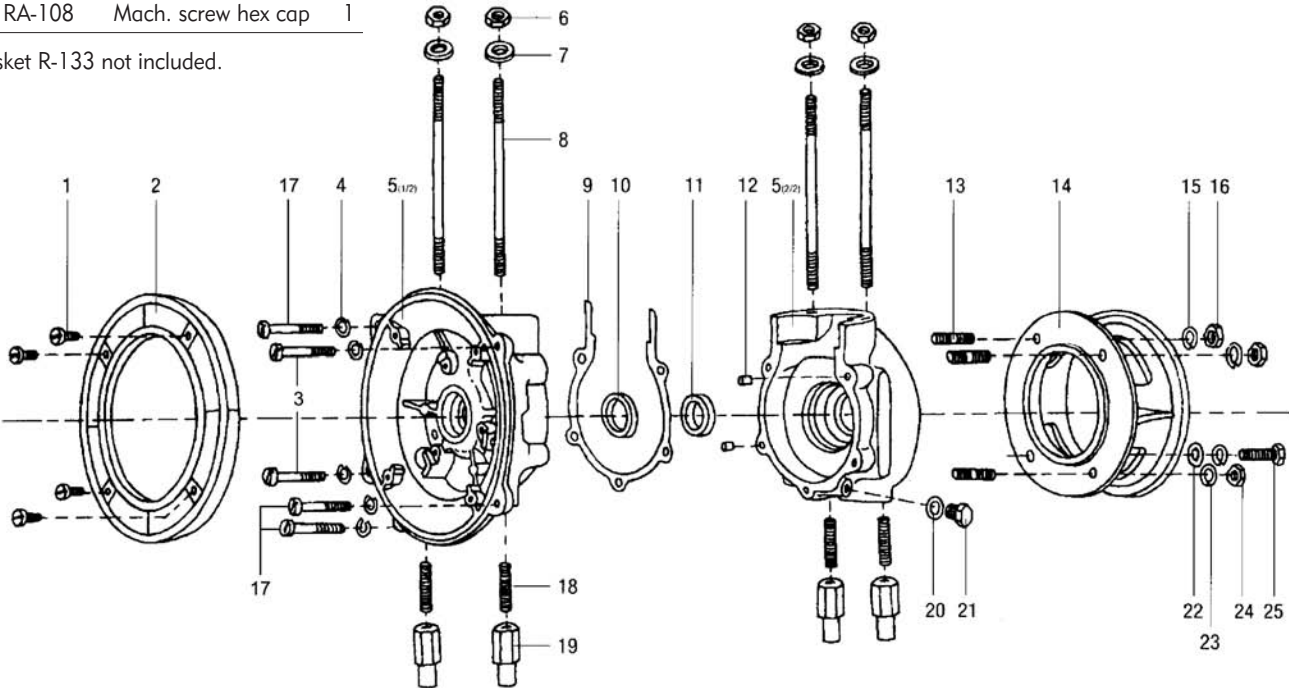
Before replacing flywheel assembly, the ignition timing should be checked. See "Ignition Timing".

- 1 Replace flywheel assembly; make certain that flywheel keyway is aligned properly with crankshaft key.
- 2 Replace lockwasher and flywheel hub nut.
- 3 Tighten hub nut to recommended torque. This is very important.
- 4 Attach fan cowl assembly.
- 5 Attach spark plug cable clamp.
- 6 Connect cable to stop switch.



Ref. #	Part #	Description	Qty
1	R-146	Mach. screw	4
2	R-144	Shield - dust	1
3	R-105	Mach. Screw	2
4	12-38	Lockwasher	5
5	R-152*	Crankcase halves set Complete with 2 dowel tubes R-103	1
6	R-120	Hex nut	4
7	R-206	Flat washer	4
8	R-236	Stud - cylinder mounting	4
9	R-133	Gasket for crankcase	1
10	R-342	Oil seal 0.983"	1
11	R-123	Oil seal 0.788"	1
12	R-103	Dowel tube	2
13	R-117	Stud	3
14	R-136	Flange - pump mounting	1
15	R-119	Lockwasher	2
16	R-120	Hex nut	2
17	R-132	Mach. screw	3
18	R-130	Stud - mounting leg	4
19	A-6149P	Mounting leg	4
20	R-113	Gasket, metal	1
21	FAST-51	Drain screw	1x
22	C-5370-11	Flat washer	1
23	R-119	Lockwasher	2
24	R-120	Hex nut	1
25	RA-108	Mach. screw hex cap	1

\* Gasket R-133 not included.



ENGINE OVERHAUL SERVICE PROCEDURE

MAJOR OVERHAUL SERVICE PROCEDURE

To replace or service the following:

- Crankshaft-connecting rod assembly;
- Crankshaft ball bearings;
- Crankcase;
- Oil seals;

Proceed as follows:

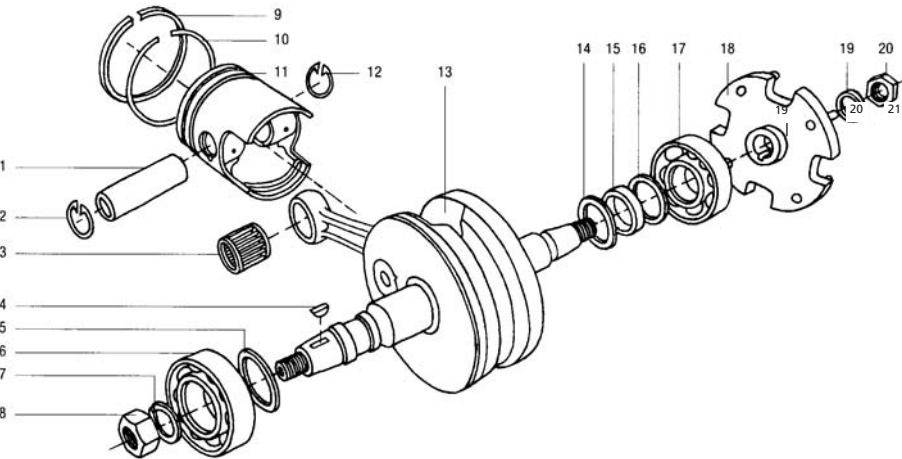
- 1 Remove pump end assembly and flexible buffer coupling disc.
- 2 Remove all wiring.
- 3 Remove screw, lockwasher and clamp, which hold spark plug cable to fan cowl.
- 4 Remove bracket R-799, which fastens to side of carburetor shroud to engine crankcase.
- 5 Remove engine from mounting frame.
- 6 Remove muffler.
- 7 Remove fan cowl with rewind starter.
- 8 Remove spark plug cover and spark plug.
- 9 Using the flywheel holding tool R-929 to prevent the collar coupling from rotating, remove nut and lockwasher from the collar coupling.
- 10 Remove collar coupling from engine with collar coupling puller R-932.
- 11 Remove manual starter rope pulley.
- 12 Remove flywheel nut and lockwasher using flywheel holding tool R-929.
- 13 Remove flywheel/magneto/fan using magneto puller R-927 and shaft protector tool R-928.



Ref. #	Part #	Description	Qty
	-	R-348 Crankshaft/conn.rod assembly (includes parts with * and oil seal R-342)	-
1	R-328	Gudgeon pin	1
2	R-329	Circlip	1
3	R-324	Needle bearing	1
4	R-305	Key	1
5	R-344*	Shim 0.004" (flywheel side)	As req.
6	R-343*	Ball bearing 0.983" ID (flywheel side) (1 piece bearing)	1
7	R-301	Lockwasher	1
8	R-303	Hex nut (flywheel side)	1
9	R-331-1	L-type piston ring	1
10	R-331	Piston ring 0.078"	1
11	R-332	Piston with rings	1
12	R-329	Circlip	1
13	R-341*	Crankshaft/conn.rod sub-assembly (includes half coupling side R-324M and half flywheel side R-341M with req. pins)	1
14	R-330	Shim, bevelled 0.040" (coupling side)	As req.
15	R-334	Spacer	1
16	R-306	Shim 0.006" (coupling side)	As req.
17	R-333	Ball bearing 0.788" ID (coupling side) (1 piece bearing)	1
18	R-315	Collar coupling	1
19	12-18	Pin	4
20	R-301	Lockwasher	1
21	R-302	Hex nut (coupling side)	1

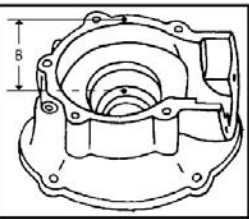
DISASSEMBLY PROCEDURE FOR ENGINE

- 14 Remove armature plate with cables.
- 15 Remove cylinder head and cylinder.
- 16 Remove piston from connecting rod.
- 17 Remove the machine screws, which fasten crankcase halves together.
- 18 To separate crankcase halves on engine with one-piece bearing, heat both crankcase halves (on the outside face of the crankcase around the bearing housing portion) to a maximum of 100 °C (212 F) and, using a plastic or rubber mallet, separate crankcase halves.
- 19 Remove crankshaft with connection rod.
- 20 Press out both oil seals using oil seal pressing tool R-933.
- 21 Remove bearings from crankshaft journals using shaft protector tool R-928 and bearing puller tool R-938.
- 22 Always change oil seals.

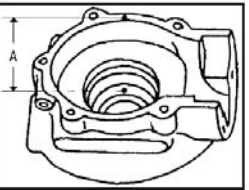


Pistons, rings and shims - optional sizes		
R-307	Shim 0.008" (coupling side)	As req.
R-308	Shim 0.012" (coupling side)	As req.
R-309	Shim 0.016" (coupling side)	As req.
R-310	Shim 0.020" (coupling side)	As req.
R-311	Shim 0.031" (coupling side)	As req.
R-312	Shim 0.040" (coupling side)	As req.
R-344*	Shim 0.004" (flywheel side)	As req.
R-345*	Shim 0.012" (flywheel side)	As req.
R-346*	Shim 0.020" (flywheel side)	As req.
R-347*	Shim 0.039" (flywheel side)	As req.
R-332-0	Oversized piston (includes rings)	-
R-331-0	Oversized piston ring 0.078"	-
R-331-0-1	Oversized L-type piston ring	-
R-321	Serrated lockwasher 12mm (used on old style engine)	-

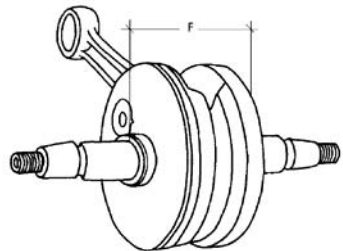
Pistons, rings and shims optional sizes		
R-307	Shim 0.008" (coupling side)	As req.
R-308	Shim 0.012" (coupling side)	As req.
R-309	Shim 0.016" (coupling side)	As req.
R-310	Shim 0.020" (coupling side)	As req.
R-311	Shim 0.031" (coupling side)	As req.
R-312	Shim 0.040" (coupling side)	As req.
R-344*	Shim 0.004" (flywheel side)	As req.
R-345*	Shim 0.012" (flywheel side)	As req.
R-346*	Shim 0.020" (flywheel side)	As req.
R-347*	Shim 0.039" (flywheel side)	As req.
R-332-0	Oversized piston (includes rings)	-
R-331-0	Oversized piston ring 0.078"	-
R-331-0-1	Oversized L-type piston ring	-
R-321	Serrated lockwasher 12mm (used on old style engine)	-



5.1 Magneto side



5.2 Pump side



5.3

REASSEMBLY SERVICE FOR ENGINE

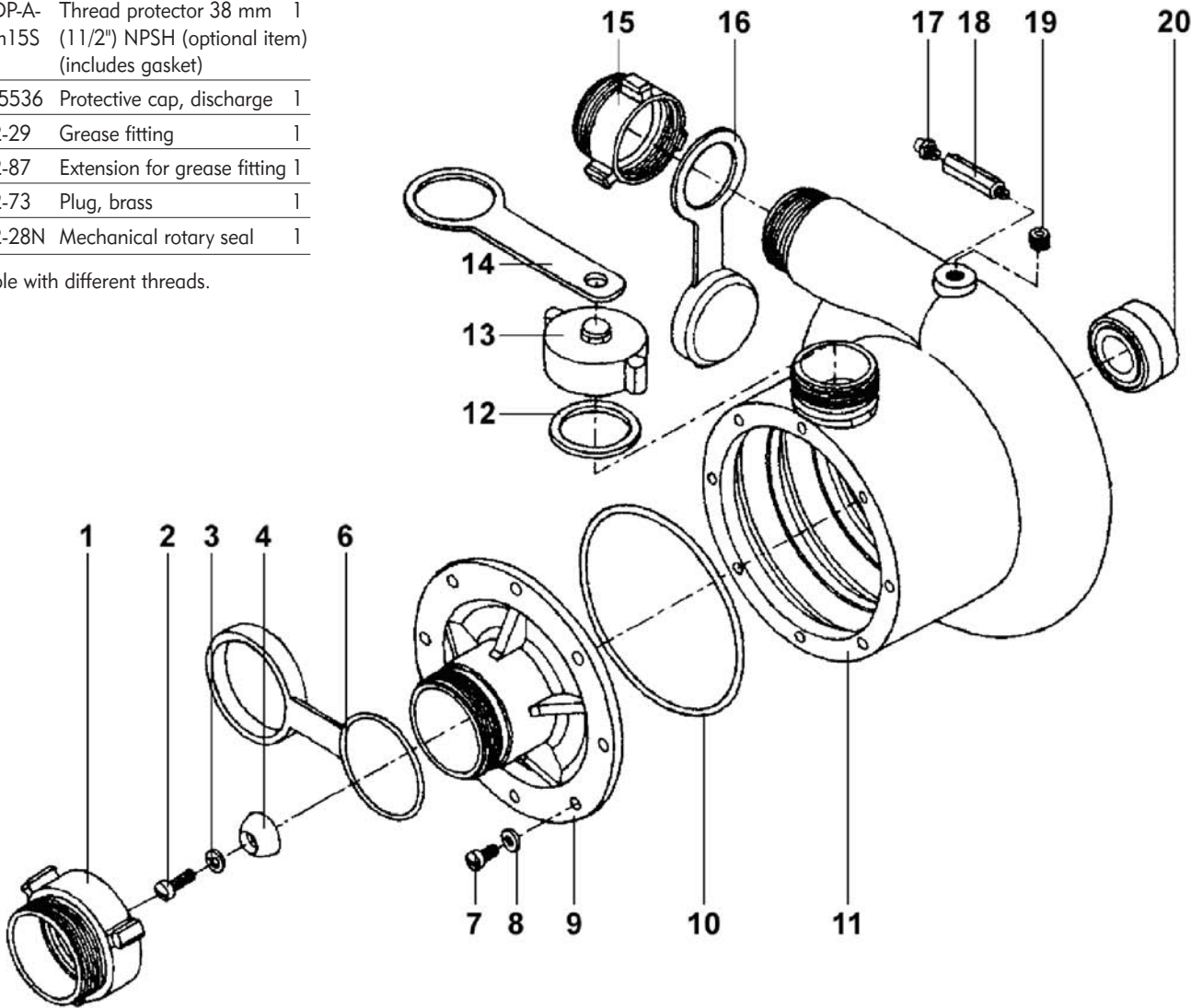
- For reassembly (1 piece bearing)
- 23 Place both crankcase halves on a table with inner faces up.
- 24 Using a depth micrometer, carefully check the distance from joint-face of each crankcase half to lower face of each bearing housing.
- For pump side crankcase half, call this dimension (A) (5.1).
  - For magneto side crankcase half, call this dimension (B) (5.2).
- 25 Measure thickness of crankcase gasket R-133. Call this dimension (C).
- 26 Subtract dimension (B) from (A). Call this dimension (D).
- 27 Measure thickness of crankshaft spacer R-334. Call this dimension (E).
- 28 Subtract (E) from (D). The answer is the thickness of shim(s) needed to centre the crankshaft.
- 29 Put the spacer and the shims (if necessary) on crankshaft (pump side) and measure the total width. Call this dimension (F) (5.3).
- 30 Select acceptable end play (see Clearance Data and Limits, page 39) and call it (G). Try (G) = 0.128 mm (0.005").
- 31 Use oil seal pressing tool R-933 to install oil seal R-342. Press bearing R-343 in crankcase half (magneto side).
- 32 Use oil seal pressing tool R-933 to install oil seal R-123. Press bearing R-333 in crankcase half (pump side).
- 33 Measure the combined thickness of 2 ball bearings. Call this dimension (H).
- 34 Subtract (H) from (G) and divide by 2. This is (J) the thickness of shim(s) to be placed on each side of the crankshaft.
- $A+B+C-F-G-H$  = shim thickness to be placed on each side of crankshaft
- 2
- Note: The crankshaft used in the electronic ignition units does not have a lobe ground into the crankshaft end.
- 35 Slide crankshaft in crankcase half (pump side). Be careful to prevent damage to lip of oil seal.
- 36 Press crankshaft into crankcase half (pump side). To prevent bending of crankshaft, be sure to always use the crankshaft jack tool R-953 (fig.1) between the webs of the crankshaft (fig.2).
- 37 Install crankcase gasket (apply some oil). **Important:** Always use a new crankcase gasket.
- 38 Slide the other crankcase half on crankshaft.
- 39 Align dowel tubes and verify that crankshaft jack and connecting rod are in piston axe (fig.3) and press crankcase halves together.
- 40 Reassemble crankcase screws and lockwashers. Tighten screws uniformly to 11-12 Nm (100-110 inch-lbs) torque.
- 41 If piston was removed, reinstall it in proper position (arrow on top of piston or balancing lumps inside piston head should be on muffler side of engine). Replace needle bearing R-324, if necessary.
- 42 Change cylinder head and cylinder flange gaskets (R-235 and R-238). Cylinder head gasket must have the large band up.
- 43 When reassembling cylinder head, be sure the "filled" part inside the head is on the muffler side of the engine (therefore, "scooped-out" part will be on the carburetor side).
- Important:** Put carburetor side on same side of spark plug cable hole in crankcase. Tighten cylinder head nuts to recommended torque as 23-25 Nm (200-220 inch-lbs). Nuts should be retorqued after first 10 hours of operation and every 100 hours after.
- 44 Reassemble remaining parts in reverse procedure used in disassembly.

Ref. #	Part #	Description	Qty
1	A-2688*	Thread protector 51mm (2") (optional item) (includes MK-138)	1
2	12-42	Mach. screw, nylon insert, Fillister head, stainless	1
3	12-38	Lockwasher, stainless	1
4	12-13	Nose for shaft	1
6	A-5537	Protective cap, suction	1
7	12-39	Mach. head screw, Fillester, stainless	8
8	12-38	Lockwasher, stainless	8
9	12-12A	Suction nozzle (includes 12-40)	1
10	12-27	O-ring	1
11	12-8	Pump body	1
12	12-43	Gasket 38 mm (1 1/2")	1
13	12-10	Cap for priming port	1
14	A-5538	Retainer for priming cap	1
15	ADP-A-Fm15S	Thread protector 38 mm (1 1/2") NPSH (optional item) (includes gasket)	1
16	A-5536	Protective cap, discharge	1
17	12-29	Grease fitting	1
18	12-87	Extension for grease fitting	1
19	12-73	Plug, brass	1
20	12-28N	Mechanical rotary seal	1

\*Available with different threads.

DISASSEMBLY PROCEDURE FOR PUMP END

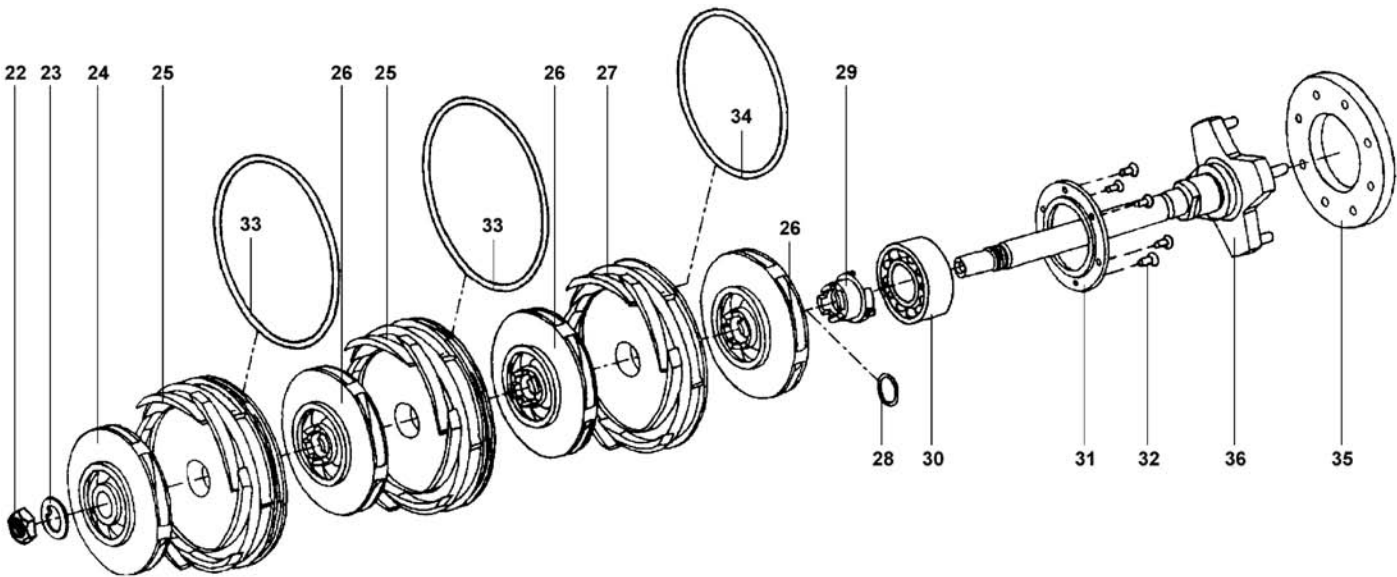
- 1 Remove shaft nose #4, by removing screw #2, and lockwasher. These will be visible upon removal of suction protective cap.
- 2 Remove screws #7, and lockwashers #8.
- 3 Using tool A-1888, remove suction nozzle #9.
- 4 Bend lockwasher #23 from locknut #22. Using tool A-1883 or 19 mm (3/4") wrench, remove locknut and lockwasher.
- 5 Remove screws #32.
- 6 Using bench-press and tools A-1890 and A-5297, press out shaft assembly. Insure removal of drive bushing #29 before attempting to continue impeller/distributor removal.
- 7 Using bench-press and tools A-1886 and A-5297, remove all internal parts. (Impellers and distributors #24, 25, 26 and 27). Operation done in jogging strokes of press ram, so that all parts will be removed in a group.
- 8 If seal #21 is badly worn or damaged, press out complete seal.



Ref. #	Part #	Description	Qty
-	12-2D	Shaft sub-assembly (includes parts with * and **, 8 items)	-
-	12-2E	Shaft sub-assembly (includes parts with **, 4 items)	-
22	12-50*	Locknut, stainless	1
23	12-49*	Lockwasher, stainless	1
24	12-11*	Impeller	1
25	12-9	Distributor	2
26	12-7*	Impeller	3
27	12-6	Distributor	1
28	B-5312-4	O-ring for drive bushing	1
29	12-4AS**	Drive bushing (includes B-5312-4)	1
30	12-48**	Double row ball bearing	1
31	12-3**	Retaining ring for bearing	1
32	12-25	Mach. screw flat Phillips, stainless	6
33	12-27	O-ring	2
34	12-26	O-ring	1
35	12-17	Coupling - buffer	1
36	12-2C**	Shaft - riveted assembly	1

ASSEMBLY PROCEDURE FOR PUMP END

- 1 Slide bearing retaining ring #31 on shaft with plain face toward coupling collar.
- 2 Install drive bushing #29 onto the shaft after the bearing has been pressed on. Ensure drive-bushing lugs are located in the 2 milled slots at the top of the rotary seal. Dial in bearing on shaft within 0,051 mm (0.002").
- 3 Remove the inside O-ring from rotary seal #21. Install this O-ring over the drive bushing.
- 4 Press rotary seal #21 in pump body using sleeve A-4329 or A-5444. This should be done carefully.
- 5 Carefully pass end of shaft assembly, through rotary seal bore. Ensure drive bushing lugs are located in 2 milled slots at top of rotary seal, then continue pushing shaft until ball bearing rests firmly against shoulder in pump body. Use the shaft aligning guide tool A-1887 to ensure that shaft is properly aligned with the pump body centerline.
- 6 Attach retaining ring #31 to pump body using six screws and tighten evenly and firmly.
- 7 Slide impeller #26 onto shaft, and engage with drive bushing #29.
- 8 Place O-ring #34 in groove of distributor #27. It is important to smear the new O-rings with a suitable lubricant used for pump ball bearing. This will facilitate the assembly.
- 9 With open end of pump body in vertical position, carefully lower distributor #27 until it rests on bottom of body.
- 10 Slide impeller #26 into position, aligning with shaft.
- 11 Place O-ring #34 in groove of distributor #27
- 12 Place distributor on open end of body, then using bench press and assembly tool A-1884, apply several light, downward strokes of press ram until distributor "drops" into body. Distributor must then be positioned by hand as before.
- 13 Slide impeller #27 into position, aligning with the other impeller.
- 14 Repeat operations #11 and #12 with parts #33 and #25.
- 15 Slide impeller #24 into position, aligning with previous impeller.
- 16 Place lockwasher #24 on shaft with locating tab in milled groove.





MAINTENANCE TOOLS FOR PUMPS

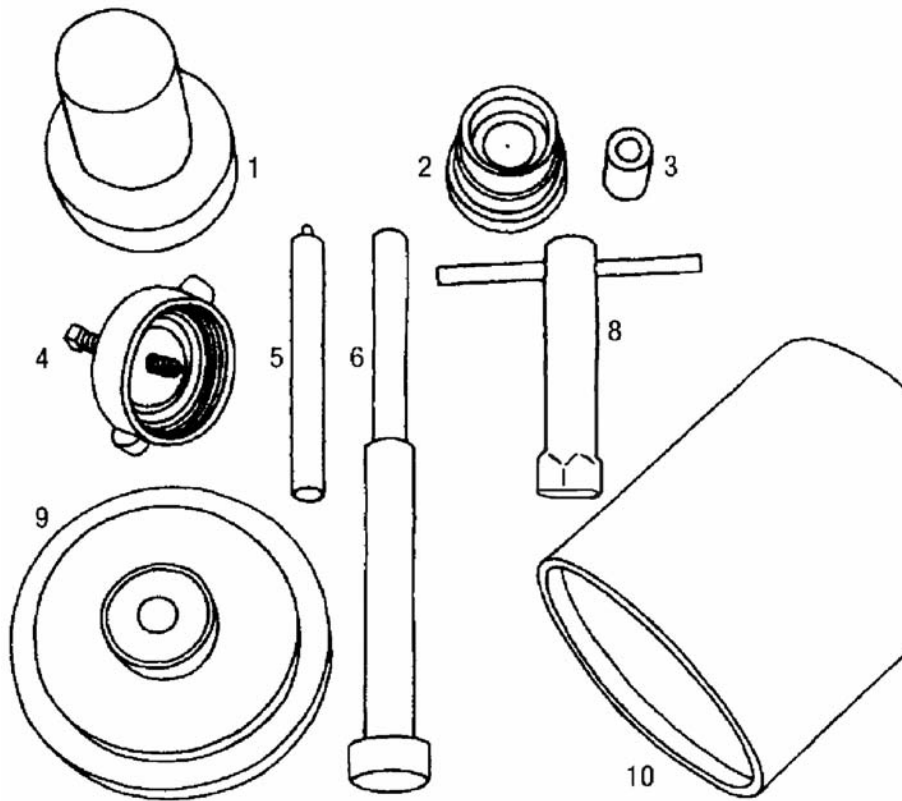
Ref. #	Part #	Description	Qty
-	A-2356	Maintenance tools for pump (includes all parts listed below)	1
1	A-1884	Pressing sleeve distributor assembly	1
2	A-4329	Pressing sleeve rotary seal assembly	1
3	A-4097	Protector - shaft	1
4	A-1888	Puller - suction nozzle	1
5	A-1890	Pressing pin shaft removal	1
6	A-1886	Pressing pin distributor removal	1
8	R-904L	Wrench - lock nut	1
9	A-1887	Guide shaft aligning, body	1
10	A-5297	Support tool	1

ASSEMBLY PROCEDURE FOR PUMP END (CONTINUED)

- 17** Screw locknut #22 onto shaft. When tightening the nut, do not use excessive force as this may result in failure of the seals, drive bushing or impellers. Do not forget to secure the shaft from rotating.
- 18** Bend lockwasher up onto one flat of the hexagon locknut at a position approximately 180° from the milled slot in the shaft. Old style locknut need to use tool A-1883 to tighten and backing-off slightly, if necessary, until one of locking tabs of lockwasher is opposite a milled slot of the locknut then lock by pushing tab into slot.
- 19** If excessive play, replace bronze bushing #4.
- 20** Place O-ring #10 in groove of suction nozzle #9, then bench press the nozzle into the pump body until it rests on face of first distributor. A gap of approximately 0,794 mm (1/32") between nozzle flange and end of body, is normal.
- 21** Attach nozzle to body by using the #8 screws and lockwashers. Tighten screws evenly and firmly.
- 22** Attach shaft nose #5 using lockwasher #4 and screw #3. Tighten screw evenly and firmly.
- 23** Check gasket in the priming cap #13 and replace if damaged.
- 24** Reinstall the suction and discharge thread protectors.
- 25** Reinstall capson suction and discharge inlets

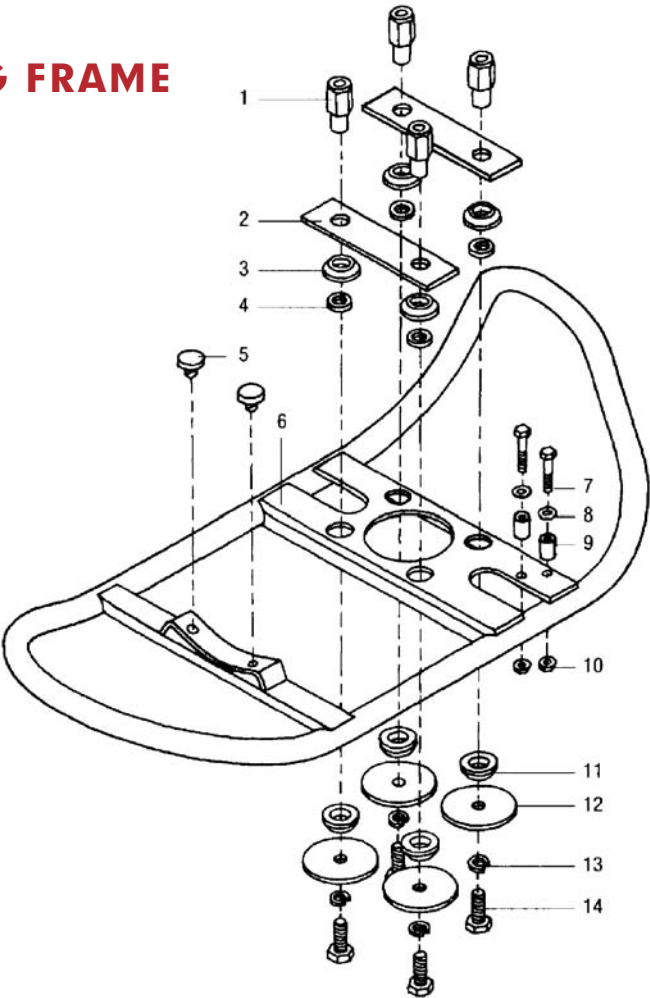
Use a clean gun filled with fresh grease. Remove dirt from grease fitting before applying grease gun. Grease should be pumped slowly into bearing chamber until fresh grease appears around bearing retaining ring. Wipe off excess grease.

A grease relief valve (old style only) has been provided to prevent pressure buildup on the rotary seal, should the fresh grease not be able to flow completely through the bearing, due to old grease being hard packed, etc.



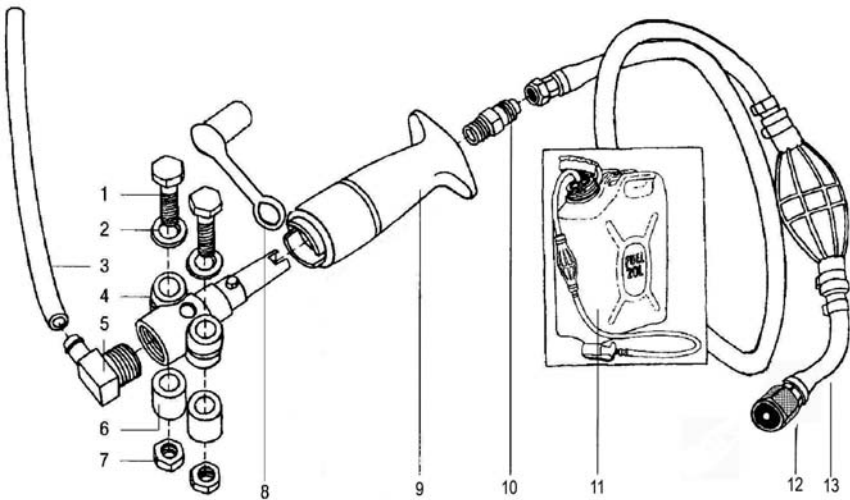
MOUNTING FRAME

Ref. #	Part #	Description	Qty
-	C-5200N	Mounting frame assembly (includes ref. #2 to #14)	1
1	A-6149P	Mounting leg	4
2	A-4005	Mounting pad	2
3	A-6179	Ring - rubber	4
4	C-5200-5	Washer - rubber	4
5	C-4506-3	Bumper - rubber	2
6	C-5201	Frame	1
7	C-5200-8	Hex bolt	2
8	D-5269-7	Flat washer	2
9	C-5200-7R	Spacer - rubber	2
10	C-6650-14	Hex lock nut	2
11	A-6179	Ring - rubber	4
12	C-5200-6	Flat washer	4
13	R-111	Lockwasher	4
14	C-5200-12	Hex bolt	4



Ref. #	Part #	Description	Qty
-	R-1114	Quick-connect fuel line (includes parts with *)	1
1	C-5200-8	Hex bolt	2
2	D-5269-7*	Flat washer	2
3	R-798*	Fuel line - plastic	1
4	R-706*	Body quick-connect male	1
5	R-709*	Elbow	1
6	C-5200-7R*	Spacer - rubber	2
7	C-6650-14*	Hex lock nut	2
8	A-7486	Dust cap M. connector	1
9	R-712	Handle quick connect	1
10	R-732	Connector	1
11	FA-552Q	Fuel air transport tank	1
12	FA-451	Fem. quick connect	1
13	12-401B-NS	Hose-fuel supply with priming bulb	1

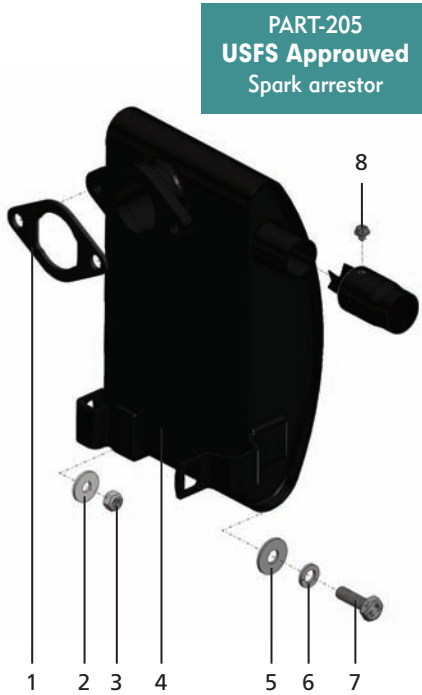
QUICK-CONNECT FUEL LINE





B-6571 shown installed on MK-3-NR.

Ref. #	Part #	Description	Qty
1	R-237	Gasket - muffler	1
2	R-151	Flat washer	1
3	R-150	Hex lock nut	1
4	R-229	Muffler	1
5	C-5370-11	Flat washer	1
6	R-119	Lockwasher	1
7	RA-108	Mach. screw hex cap	1
8	PART-205	Spark arrestor	1



OPTIONAL NOISE REDUCTION MUFFLER

B-6571 Noise Reduction Muffler

With its extra internal baffling, and larger size, the new B-6571 muffler was specifically designed to reduce MK-3 operating noise level by approximately 10%.

DECARBONISING

After several hours of normal operation, carbon deposits will form on piston crown, cylinder head, in the cylinder exhaust port and around piston rings and in the ring grooves, causing erratic and faulty operation. The piston skirt may also show signs of gum and varnish deposits.

To decarbonise, the cylinder head, cylinder and piston should be removed. All carbon deposits should be carefully removed, particularly from the piston ring grooves. After removing carbon, wash all parts in a suitable solvent, then dry with compressed air. On reassembly, always use new piston rings.

After every 100 hours of operation, or more often if a loss of power is indicated, the engine should be decarbonised.

To decarbonise the engine, proceed as follows:

- 1 Remove muffler. If muffler is very dirty internally or appears burned or cracked, it should be replaced with a new muffler.
- 2 Remove cylinder head and cylinder head gasket.
- 3 Rotate crankshaft until piston is at bottom dead centre.
- 4 Using a brass scraper tool, carefully scrape carbon deposit from exhaust port. During this operation, tilt engine so that deposits will not fall into combustion chamber.
- 5 Use suitable brass tool to push out any carbon deposit which may have formed in the hole provided in the cylinder liner for bypass.
- 6 Rotate crankshaft until piston is at top dead centre.
- 7 Use a stiff (not wire) brush to remove loose, flakey carbon from top of piston. Do not remove hard deposit of carbon, as this layer forms a natural heat insulator to protect the piston crown.
- 8 Remove all carbon deposits from cylinder head.
- 9 Replace cylinder head. Tighten nuts uniformly to recommended torque 23-25 Nm (200-220 inch-lbs) value. Always use a new cylinder head gasket (cylinder head gasket must have the large band up).
- 10 Check and replace muffler gasket if worn or damaged. Reinstall muffler.

TORQUE VALUES

ENGINE	
Spark plug	41 Nm / 360 inch-lbs (30ft-lbs) (41Nm)
Cylinder head nuts	23-25 Nm / 200-220 inch-lbs Should be retorqued every 100 hours of operation.
Flywheel hub nut	44-45 Nm / 390-400 inch-lbs
Collar coupling nut	11-14 Nm / 100-120 inch-lbs Crankshaft with no keyway at PTO end should be torqued to 19-21 Nm / 175-185 inch-lbs.
Crankcase assy. screws	11-12 Nm / 100-110 inch-lbs
PUMP	
Retaining ring screws	6,7-7,3 Nm / 60-65 inch-lbs
Shaft nose screw	7,9-8,5 Nm / 70-75 inch-lbs
Nut #12-50	28-29 Nm / 250-260 inch-lbs.
Suction nozzle screws	7,9-8,5 Nm / 70-75 inch-lbs

CLEARANCE DATE AND LIMITS  
ROTAX

ENGINE	
Spark plug type	Bosch M4AC18mm
Spark plug gap	0,41-0,51 mm / 0.016"-0.020"
Breaker points gap	0,35-0,45 mm / 0.014"-0.018"
Ignition timing limits	2,54-4,01 mm / 0.100"-0.158" BTDC
Ignition timing - nominal	2,54mm / 0.100"BTDC
Magneto air gap	0,25-0,33 mm / 0.010"-0.013"
Condenser capacity	0,15-0,19 mF
Normal current for testing coil	1,0 amp. nominal / 2,0 amp. max.
Crankshaft end-play	0,025-0,230 mm / 0.001 "-0.009"
Cylinder bore (hone)	62,50-62,51 mm
Cylinder Surface Roughness	1-2 Micron / 39-70 microinches
Piston dia. - nominal	61,94 mm/2.4386"
Piston dia. - oversize	62,44 mm / 2.4583"
Piston / cylinder clearance	0,06-0,08 mm / 0.0024"-0.0032"
Wear limit	0,20 mm / 0.0079"
Cylinder taper	max. 0,08 mm / 0.0032"
Cylinder out of round	max. 0,05 mm / 0.0020"
Piston ring end gap (new ring)	0,20-0,35 mm / 0.0079"-0.0138"
Wear limit	1,00 mm / 0.03937"
Piston pin hole dia. (in piston)	18,001-18,005 mm / 0.7087"-0.7089"
Piston pin dia.	17,997-18,000 mm / 0.7085"-0.7087"

CLEARANCE DATE AND LIMITS (CONTINUED)

Crankshaft halves run-out	0,03 mm/0.0011"
Crankshaft bearing seat dia. (on crankshaft coupling side)	20,002-20,011 mm / 0.7875"-0.7878"
Wear limit (on crankshaft flywheel side)	20,000 mm / 0.7874"
Wear limit	25,002-25,011 mm / 0.9843"-0.9847"
Wear limit	25,000 mm / 0.9843"
Crankcase bearing seats dia. (both sides)	51,95-51,96 mm / 2.0453"-2.0457"
Wear limit	51,98-51,99 mm / 2.0465"-2.0469"
Connection rod inside dia. (for piston rim bearing)	21,997-22,005 mm / 0.8660"-0.8663"
Ring / piston groove clearance	0,04-0,11 mm / 0.0016"-0.0043"
Wear limit (measured on rectangular rings only)	0,2 mm / 0.0079"
Stroke	61 mm / 2.40"

Pump	
Impeller #12-7 diameter	93,22 mm ±0,13 / 03.670" ±0.005
Impeller #12-7 width	38,86 mm ±0,05 / 1.530" ±0.002
Impeller #12-11 diameter	93,22 mm ±0,13 / 03.670" ±0.005
Impeller #12-11 width	34,11 mm ±0,05 / 1.343" ±0.002
Distributor #12-6 diameter	123,39 mm-123,47 mm / 04.858"-4.861"
Distributor #12-6 width	31,31 mm ±0.05 / 1.234" ±0.002
Distributor #12-9 diameter	0123,39 mm-123,47 mm/04.858"-4.861"
Distributor #12-9 width	34,11 mm ±0,05 / 1.343" ±0.002
Pump inside depth	108,10 mm ±0,05 / 4.256" ±0.002
Pump ball bearing housing	51,99 mm-52,02 mm / 2.047"-2.048"
Nozzle bushing bearing housing	19,037 mm-19,063 mm/0.7495"-0.7505"
Buffer thickness (#12-17)	8,25 mm-8,89 mm / 0.325"-0.350"
Shaft ball bearing support	25,004 mm-25,011 mm/0.9844"-0.9847"
Shaft bushing bearing support	12,687 mm-12,700 mm/0.4995"-0.5000"
Shaft maximum run-out	0,0889 mm / 0.0035"



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12-43	Gasket, 38 mm (1 1/2")	34
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# 9 WARRANTY CERTIFICATE



Wildfire Group warrants its manufactured products to be free from defect in material and workmanship, under normal use and service, for a period of one (1) year or one hundred (100) hours of usage, whichever comes first.

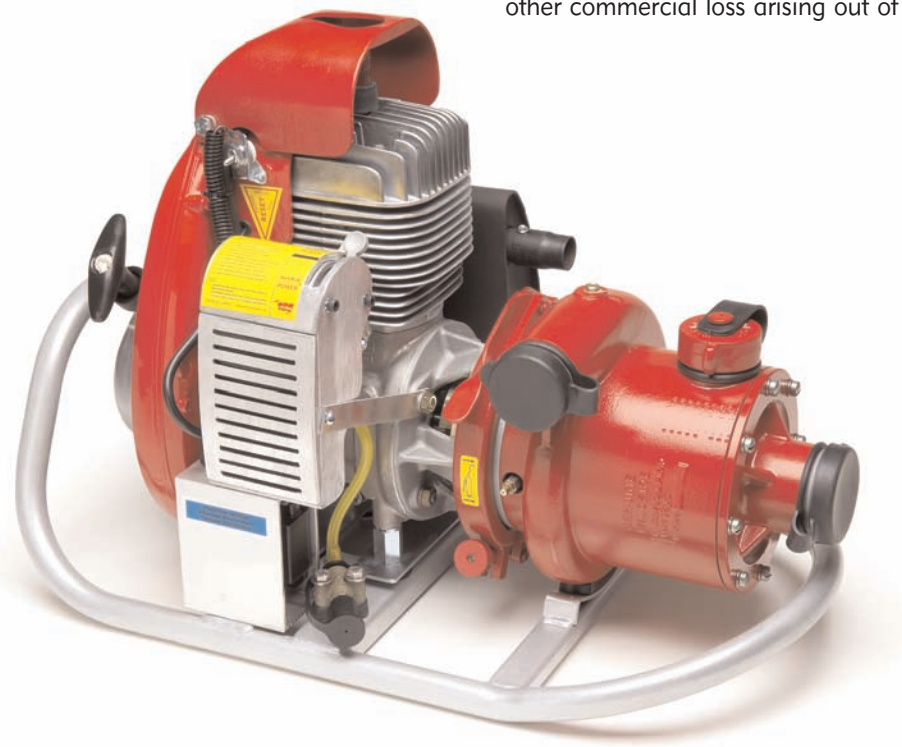
This limited warranty is effective only if the equipment or apparatus is used as directed, is not subjected to misuse, negligence or accident, and is not altered, threaded or repaired by anyone other than Wildfire Group, ("Wildfire") personnel or one of its authorized representatives. Items sold but not manufactured by Wildfire shall bear only the limited warranties offered by their respective manufacturers.

Any return of defective goods for repair or replacement must be accompanied by a copy of the warranty registration form with the returned material authorization section properly completed. The authorization number will be given upon request by telephone or mail. An authorized representative may then be designated by Wildfire to handle the claim on its behalf.

The claimed defective equipment must be delivered; freight prepaid, to Wildfire at its listed address or to the representative, no more than thirty (30) days after the returned good authorization number (RGA) has been processed by Wildfire. Wildfire will inspect the equipment and reserves the right to refuse responsibility if it is found that the equipment failed for another reason than a defect in material or workmanship.

Wildfire shall not be liable for consequential or indirect damages or contingent liabilities including but not limited to: loss of life, personal injury, loss of crops, loss due to fire or water property damage, and consequential or indirect trade or other commercial loss arising out of the failure of manufacturer's product.

**Wildfire Group**  
1100 Norman Street, Suite 200  
Lachine, Quebec, Canada  
H8S 1A6  
Tel.: (514) 637-5572  
Fax: (514) 637-3985



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